THURSDAY, JANUARY 14, 1915.

THE WAR.

THE war drags on; and we are learning to understand the mentality of the German race more completely. It is being revealed in various forms. The policy always adopted by the bully, of attempting to terrorise by attack on defenceless persons, is shown by the shelling of the watering-places of Yorkshire, resulting in the murder (for that is the only word which fits the case) of 103 harmless people. "Murder" should certainly have been the verdict, although it was disallowed by the coroner; for although the commanders of the German vessels may not yet be known by name, a verdict of murder would have rendered them subject, when captured, to trial by a British jury. The cowardly and murderous onslaught has led, we are told, to rejoicings in Berlin. It is as we feared; the German nation has lost its moral perspective. They may rest assured, however, that there will be no similar reprisals on the side of the Allies. We do not revenge ourselves on innocent women and children.

It was scarcely worth while, perhaps, for the French universities and British men of letters and science to have replied to the self-named "intellectuals" of Germany. Neutral countries have already made up their minds from the perusal of official documents, not the least important being those from German sources, that the war is one of pure aggression on the part of the Germans. We hear from Switzerland, from America, and from Scandinavia that the public in these countries now pay no attention to German polemic literature. If they had conceivably had any case, they have given it away by their inhuman acts, which have raised a sentiment of disgust in every civilised mind.

We look with contemptuous amusement at the childish renunciation of foreign honours by our Teutonic colleagues in science. That is even the attitude of some of their own countrymen; Prof. Verworn, of Bonn, writing in the *Berliner Tageblatt*, describes it as unworthy of German men of science, and Profs. Waldeyer, Martin, and Orth have protested against the foolish conduct of their countrymen. We can only shrug our shoulders and say that the loss is theirs, not ours.

We have also been disillusioned by the words of the well-known Celtic scholar, Prof. Kuno Meyer, late of Liverpool University, now of Berlin, who has acted, and is acting, as an agent of the Prussian Government in attempting to excite the feelings of Nationalist Ireland and of American Irish in favour of Germany. Here is a man, eminent in his own subject, speaking English without an accent, who has spent thirty years of his life in an English university, a man who has (or had) many intimate friends in this country and has been received in many English households as a friend, turning out to be a dastardly enemy. Savages have a code that, after breaking bread in a man's house, it is treacherous to war against him; not so Prof. Kuno Meyer. This is evidently another instance of "Kultur." It behoves us to treat with suspicion all naturalised aliens of Teutonic extraction; and yet we know, alas! that in doing this, we are acting unjustly in some cases. But the individual, in these days, must suffer for the crimes of his countrymen. It is such instances as these which make the Allies determined that such a race must be deprived of power to do further mischief, whatever be the cost in life and money.

Some correspondence has appeared in the Press as to the relative merits of German contributions to science, as compared with the achievements of members of other races. The discussion is perhaps a useful one; for there is little doubt that the German estimate of the scientific ability of their own people is a much exaggerated one. The statement made in a previous issue of NATURE (October 8) that German science has not been remarkable for originality appears to meet with general assent. We in England have been always more intent on welcoming a discovery than in inquiring into the nationality of the discoverer; indeed, it is a common saying that science is international. But we are beginning to revise our verdict. Prof. Karl Pearson, Prof. Sayce, and Sir E. Ray Lankester have shown that Germany has played only a small part in inception of scientific truths, although by organisation she has greatly extended their application. Huxley and Bywater held this view, each as regards his own subject; and it appears to be shared by geologists, physicists, and chemists. "Ausarbeiten" is the goal of the Germans; the inventive faculty has not been their strong point. Perhaps a mixed race gains in original ability; both flint and steel are necessary to produce a spark. But one thing the German man of science knows how to do well—to exalt the achievements of his nation, often by ignoring that of others. This has probably been done in many cases without intention; it appears to be one way in which German patriotism manifests itself.

Dr. Hugo Schweizer, an Americanised German,

writing in the *Popular Science Monthly* (December issue), maintains the thesis that the development of science owes much, if not all, to the stimulus of the demands of Prussian military requirements. Naturally, his examples refer entirely to technical applications of science. And here, again, if they are analysed, it can be shown that the development of which he boasts is due to concentrated and organised effort; of the starting-points of the manufactures which he cites, few are of German origin. They have been appropriated and worked out, no doubt, in order to place the materials of war at the disposal of the German Army; but it is not proved that the necessities of peace are not more effective as a stimulus to progress than those of war. To take only one instance, it is probable that sooner or later all our railways will be electrified; but that would not suit military exigencies; each train must have an independent motive power; and so long as German militarism persists, we may reckon that German railways, at least, will not be run by the electric current.

The aims of science are the antitheses of those of war. It is the object of pure science to attempt to know and correlate natural phenomena, and its devotees are inspired by an insatiable curiosity; it is the object of applied science to make use of that knowledge for the benefit of mankind. To degrade its applications to the destruction of life and property is the most unscientific act of which a people can be guilty.

LORD AVEBURY: BANKER AND NATURALIST.

Life of Sir John Lubbock, Lord Avebury. By H. G. Hutchinson. Two vols. Vol. i., pp. xiv + 338. Vol. ii., pp. x + 334. (London: Macmillan and Co., Ltd., 1914.) Price 30*s.* net, 2 vols.

SIR John Lubbock was a notable figure in the period of our scientific history which saw the birth and development of evolutionary theory. If the part he played was not as weighty as that of Lyell, of Huxley, and of Hooker, it was even more effective. For he spoke as a man of affairs and with convinced sincerity; and if he was "a great banker amongst scientists" so much the better. Like Spottiswoode, he could show that a scientific mind was capable of business success; both, in fact, were members of the X Club, that mysterious body, impossible of successor, which was said "to govern scientific affairs," and "not to do it badly"; Lubbock was, indeed, its last surviving member.

Biography is an art in which any great measure of success is rare. For it demands that the subject should reveal itself while we remain almost unconscious of the hand of the artist. Mr. Hutchinson is more artless, and rivals Boswell in the feat of giving us himself as well. He could not draw on letters, the biographer's best resource; to Lubbock, he explains, "exposure of the holy sanctities of his being would have been impossible." Apology seems unnecessary, then, for Lubbock's "attending the services at the village church" and reading his Bible, though Huxley did the latter and to some purpose. The explanation is found in the belief "that there was some room, after all, among the atoms for the spirits." After this it is pleasant to know that 40,000 people attended the last race meeting in his father's park at High Elms; amongst them were the Archbishop of Canterbury and the Lord Chancellor, evidently spirits. Picking holes is rather futile. But two statements, at any rate, catch the eye as perplexing. Sir Gabriel Stokes (i., 85) is made to say that the chance of laying the first Atlantic cable was "only $(\frac{19}{20})20 = \cdot 3585$, or about 2 to 1 against it"; obviously this should be $(\frac{19}{20})^{20}$, and one wonders who and what was the "Consul D'Êtat" (ii., 23) whom Lubbock went to see in Paris.

Mr. Hutchinson says reasonably enough that to anyone who did not know Lubbock's "serene, unruffled calm" one might easily conceive him as "an animated hurricane." Even to read the life is like travelling in an express train with but a blurred impression of successive landmarks. Only one of his many personalities needs treatment here, and that requires a little more justice than it has always received.

Lubbock's father was a mathematician of some repute, and treasurer of the Royal Society when the Duke of Sussex was little more than nominal president. His mother notes that at the age of four "His great delight is in insects." He was some four years at Eton, where he was thought "exceedingly inaccurate," but that must be taken in an Etonian sense. "Against the advice of his tutor he read some natural history and geology." At the age of fourteen his father was obliged to make use of him in the bank. "He and I with a worthy old clerk carried on the business." Lubbock thought that "beginning so early gave him an instinct for business," and well it might. At the age of nineteen he made a minute time-table for his day from half-past six to midnight. Science and literature fill the compartments; 9.30 to 10 was devoted to "sermons (if I read them any later they invariably send me to sleep)." Such a discipline would have sterilised most men. But his neighbour Darwin gave him a wider training.

He did much sound and valuable work in entomology, and at the age of twenty-four was elected into the Royal Society. He had already made the acquaintance of many well-known scientific men.

And then in 1860 came the "Origin." Lubbock warmly grasped the principle of evolution. The same year he saw Boucher de Perthes at Abbeville; he satisfied himself as to the human manufacture of its stone implements, and that they were contemporary with the mammoth. In 1865 he published "Prehistoric Times." Darwin wrote, "Though you have necessarily only compiled the materials, your general result is most original." He was then contesting Maidstone and was advised to keep the book back, but thought it "would be scarcely honourable"; it is believed to have increased the majority against him. It is rather remarkable that Mr. Hutchinson thinks his writing wanting in "style." Darwin in this respect, and he was no mean judge, thought the book "perfection." A little later he showed that our bronze implements were not, as supposed, of Roman date, and he established against Ferguson the prehistoric age of Stonehenge and Avebury. He secured what was left of the latter from destruction by the builder.

The "Origin of Civilisation" followed in 1870. Frazer admits that it contributed to his own opinions as to the evolution of religion and society, and that Lubbock had anticipated him as to the relation between magic and religion, and the priority of the former.

In his later life he occupied himself with geology and botany, but always from an evolutionary point of view. The former won him the Prestwich medal. He was a keen observer; when exploring with Huxley and Tyndall the lake-dwellings in the Lake of Geneva, he dived more than once after a supposed stone axe, and he produced consternation amongst Swiss geologists by finding nummulites in a rock mapped as Triassic. His botanical work has been thought to deal too much with the trite and obvious, and perhaps it was so to the instructed. But our scientific knowledge is too much a thing apart from ordinary life, and Lubbock wanted to extend its field; no one could be more competent for the task. His "British Wild Flowers considered in Relation to Insects" would be a revelation to most people. The later "Notes on the Life History of British Flowering Plants" show that mere "collecting" leaves the problem of every species untouched. In his great work on "Seedlings" he availed himself of the help of others; it breaks new ground which still awaits a generalisation.

In literature he has been subject to the same criticism. The answer is the wide-world popularity of his writings; the "Pleasures of Life" "was the first book ever published in the Soudan." "Best Books" are on every bookstall.

Lubbock was an optimist. He enjoyed life and laboured that his fellow-creatures might enjoy it more. To that end, as Lord Buxton tells us, he could suppress "interest and desire" if they conflicted with his purpose. His life has been described by one who knew him well as "one of the most useful that was ever lived." It is a worthy epitaph.

ARBORICULTURE AND FORESTRY.

Trees and Shrubs Hardy in the British Isles. By W. J. Bean. 2 volumes. Vol. i. Pp. xvi+688. Vol. ii. Pp. vi+736. (London: John Murray, 1914.) Price 42*s.* net, two vols.

THE appearance of this book, the work of the Assistant Curator of the Royal Botanic Gardens, Kew, will be welcomed by all who are interested in hardy trees and shrubs, for it is the best and most comprehensive work upon the subject that has appeared since the advent of "Loudon's Encyclopædia of Trees and Shrubs," more than seventy years ago. The need for such a work has long been evident, for Loudon's book is hopelessly out of date, not only by reason of the large number of plants which have been introduced in the intervening years, but also on account of the many changes which modern research have necessitated in nomenclature. Since Loudon wrote his famous book the rich regions of western North America, Chile, China, Japan, and other countries have been ransacked for horticultural treasures, and the scope of the present work places good descriptions of these and other woody plants in an easily available form.

The book is divided into two parts, the first being devoted to chapters on cultural requirements and various special subjects, whilst the latter is given up to descriptive matter. The opening chapter gives an interesting epitome of the history of the introduction of hardy exotic trees and shrubs to the British Isles between the middle of the sixteenth century and the present date, due credit being given to the many nurserymen, collectors, and private individuals who encouraged and made such work possible. Following this are chapters upon propagation, hybridising and selection, nursery work, transplanting, arrangement of shrubberies, staking and other means of support, pruning, care of old trees, evergreen trees and shrubs, climbing shrubs, pendulous trees, fastigiate or erect-branched

trees, dwarf trees and shrubs, trees and shrubs with handsome fruits, handsome-barked trees and shrubs, variegated and coloured trees and shrubs, fine-foliaged trees and shrubs, autumnal colour in trees and shrubs, early- and late-flowering trees and shrubs, street planting, hedges, trees and shrubs for wet places, shrubs for dry positions and poor soils, shrubs for shady places, and trees and shrubs for the seaside.

All the necessary general information upon each subject is given in a clear and concise manner, but special details of culture required by individual plants are given later in the descriptive part of the work. The early part of the book will appeal specially to the purely practical man, but the more important part, which commences at page 113 of vol. i., and is continued to the end of the second volume, will be found to be of value to everyone who is interested in hardy ligneous plants, whether from the point of view of the botanist, student, landowner, gardener, or forester. Descriptions are given of all the species of trees and shrubs, so far identified, which are of any importance in the British Isles, with many of the most distinct botanical varieties, and in almost every case the descriptions have been prepared from living plants in the Kew collections. The arrangement of genera and species is, as far as possible, alphabetical, this arrangement only being altered where two species are very closely allied, and the distinguishing features can be more clearly defined when the descriptions run concurrently. An ample index of some forty pages, however, atones for this little digression.

One system of description obtains throughout the work. The name of each genus appears in large capitals with the order to which it belongs in small capitals. Then follows a general description of the genus with distribution and special cultural directions. The principal species are then described, each description being headed by the scientific and common names, and, when necessary, the chief synonyms, together with an indication as to where a good botanical drawing of the plant can be found. The following description gives an idea of the general style of the work :—

L. TRAGOPHYLLA, *Hemsley*. CHINESE WOODBINE.
(Bot. Mag., t. 8064.)

A deciduous climbing shrub, with smooth young shoots. Leaves oval, tapering about equally to both ends; 2 to 4½ ins. long, ¾ to 2 ins. wide; slightly glaucous above, glaucous and slightly downy beneath. The uppermost pair of leaves are wholly united by their bases, forming a diamond shape; the next pair lower down are less united, but still clasp the stem; still lower down come short-stalked leaves. Flowers bright yellow, produced in a terminal head of ten to twenty. Corolla-tube 2½ to 3½ ins. long, slenderly cylindrical, smooth outside, downy within; across the two lips the corolla measures 1 in. or more in width. Berries red.

Native of the province of Hupeh, China; discovered by Henry and introduced for Messrs. Veitch by Wilson in 1900. It flowered for the first time at Coombe Wood, in July, 1904. L. Caprifolium is closely related, but differs in its whorled flowers and in the smooth interior of the corolla-tube. L. tragophylla is the largest flowered and most showy of the true honeysuckle (Periclymenum) group. It likes a deep moist loam, and Mr. Wilson recommends for it a semi-shaded position.

It will thus be seen that the descriptions are clear, concise,and ample for all practical purposes. Botanical terms have been avoided whenever possible, but in such a work they could not be excluded, and for the benefit of readers who are unfamiliar with such terms an excellent glossary precedes the commencement of part ii.

Mr. Bean's intimate connection with the Kew collections for upwards of a quarter of a century, coupled with his keen powers of observation and critical knowledge of everything connected with hardy ligneous plants, offer a sufficient guarantee for the thorough trustworthiness of the book, and it should find a place in the library of every lover of trees and shrubs, whilst nurserymen and others would do good work, and indirectly pay a graceful compliment to the author, by adopting it as the national standard of nomenclature.

The publisher has done his share in a manner worthy of the firm, and Mr. E. J. Wallis and Miss E. Goldring are to be complimented upon the photographs and drawings. Both author and publisher are to be congratulated upon the production of a book which is likely to be the standard work upon trees and shrubs for at least half a century.

W. DALLIMORE.

FIRST PRINCIPLES OF MATHEMATICS.

Neue Grundlagen der Logik, Arithmetik und Mengenlehre. By Julius König. Pp. viii + 259. (Leipzig: Veit and Co., 1914.) Price 8 marks.

THIS is an interesting and very readable book which, with a comparatively small amount of new notation, discusses the elements of the theory of sets. The most original section is that on "logical forms"; this is a theory of induction more or less corresponding to Whitehead and Russell's theory of types, and axioms of reducibility. The most controversial chapter is that on Zermelo's axiom, and the principle of selection; here the author is very ingenious, but, we fear, not very convincing. Given a class (*a*, *b*, *c*, . . .) he treats the term "*a* or *b* or *c* or . . .", that is (nearly)

in ordinary language, "any arbitrary element of the class" as a definite object. He quite rightly observes that this is not an element of the class; but he goes on to say, "In spite of this 'or,' '*a* or *b* or . . .' is a clear experience of our thinking." Of course it is for certain small finite sets, but if we try to extend it, as the author does, to infinite sets, there seems to be a risk of begging the question at issue in the theory of selections. What we want is to justify, and generalise, so far as we can, such expressions as "*take* an arbitrary point on the given circle," "*take* an arbitrary prime number," and so on.

These two examples are of the same type, but they will serve to show part of the difficulty of the question. When a circle is drawn, few would object to the postulate "It is possible to choose an arbitrary point on the circle," it seems so obvious intuitively. But now consider the set of primes, and suppose them arranged in order of magnitude; the millionth of them is a definite existent prime, but what do I mean by "taking" it? I cannot take it in the same sense as I can take two or three or 101, because it has not, so far as I know, been calculated; so I must consider "taking" it as specifying it by a description, belonging to it and to nothing else. But what is there in the general definition of a class to enable us to take an element of it, in the sense required for the theory of selections? How can I "take," for instance, an arbitrary sound or colour? What sort of set (mathematically) is that of pure musical tones? Can we arrange all periodic sounds ordinally? and so on.

It is rash for an outsider to intrude upon such a thorny topic, but we cannot help surmising that Zermelo's axiom (or an equivalent to it) may be like the axiom of parallels in geometry; not necessarily true, but leading, if assumed, to a large body of valuable conclusions. In geometry we have practically only two alternatives to the parallel axiom; it took a long time to discover them, and the only way to disprove the truth of Zermelo's axiom is to find a case that contradicts it. Meanwhile, a safe course is to imitate Whitehead and Russell, and introduce the axiom as a working hypothesis.

It may be noticed that the author pays a warm tribute to Russell's important contributions to the theory of logic. There can be no doubt that they have done much to advance clear thinking, and avoidance of fallacies.

The work is, unfortunately, not quite complete, as the author died before finishing the last chapter. His portrait is given as a frontispiece.

G. B. M.

EGYPTIAN FOLKLORE.

Amulets, Illustrated by the Egyptian Collection in University College, London. By Prof. W. M. Flinders Petrie. Pp. x + 58 + plates. (London: Constable and Co., Ltd., 1914.) Price 21*s.* net.

PROF. PETRIE is certainly right in suggesting that the subject of Egyptian amulets is one that appeals to the reader of folklore as well as to the Egyptologist. In amulets we are dealing with magic in a concrete form, and it is a problem of no small fascination to recover the meaning which underlay the origin and use of each. It will be obvious that a wide knowledge of Egyptian religious belief is essential, if we are rightly to understand those amulets of peculiarly Egyptian origin. But where the texts fail us we are necessarily thrown back upon comparison with amulets of other races, particularly those of Central African tribes. It is here that folk-lore finds its opportunity, for it not infrequently supplies a clue to the meaning of an otherwise obscure or doubtful symbol.

In the work before us Prof. Petrie has combined both these converging lines of research in a remarkable degree. His material is mainly drawn from amulets in the University College collection, which, as the result of excavation and purchase carried out for many years, he has made as varied as possible; but he has also supplemented these with reference to examples in other collections. He has consequently been able to describe some two hundred and seventy different kinds of amulets, and his classified list, largely the result of pioneer work, places the study upon a scientific basis. Under each heading the Egyptian name is given when known, its meaning and use are suggested, varieties, periods, and material are noted, and references given to the collections where specimens occur.

In his discussion of general principles, the author is certainly right in dismissing with scant sympathy the "confidence theory" and the "faith theory," for though these undoubtedly explain the actual efficacy of amulets, they are entirely out of place as explanations of origins. By far the greater number of Egyptian amulets are most satisfactorily interpreted on the principles of sympathetic magic, or in Prof. Petrie's own phrase, by the "doctrine of Similars." The whole body of funereal magic, as practised by the ancient Egyptians, partakes of this general character, and it is but natural that amulets, whether worn by the living or the dead, should fall under the same category. It is only when we come to detailed explanation that lines of underlying

thought or feeling sometimes remain uncertain and obscure. For in sympathetic magic the most obvious connection is not necessarily that which actually led to the employment of a particular object or substance. To take a single example. Prof. Petrie compares the Egyptian series of animal-claw amulets with a leopard's claw from Central Africa (Leicester Museum), and he explains it as an amulet for protection from wild beasts. This explanation at first sight commends itself as not only reasonable but obvious. Yet when we turn to Burton's "Central Africa" we find that in Central Africa the "mganga" or sorcerer might employ a leopard's claw for curing disease. The spirit or ghost with which the sick man was believed to be possessed could by drumming and dancing be driven out of him into a leopard's claw, and when this was hung to a "devil's tree" the disease-spirit was laid. It is true that the leopard's claw was not essential to the process, for in its place a peculiar bead, a nail, or even a rag could be used as the medium for exorcising the disease. But the fact of its employment for this purpose in Central Africa at least suggests the possibility of some other explanation of its use in ancient Egypt than the fear of attack by wild beasts. In several other cases the possibility also suggests itself that the original reason for the use of an object in primitive magic may not have coincided with its later associations when it had survived as an amulet worn on the person.

We have merely referred to these points as indicating the wide interest attaching to the study of the subject. We cannot conclude without a reference to the excellent photographic plates, as well as to the chapters on the use of amulets, in which not only the student and collector, but also the general reader will find much to interest him. L. W. K.

OUR BOOKSHELF.

Science and Religion. By Seven Men of Science. Pp. 138. (London: W. A. Hammond, 1914.) Price 1*s.* net.

In a week of November last, a series of seven addresses upon the mutual relations of science and religion were delivered by scientific men of distinction at Browning Hall, Walworth Road, London. The lecturers were Sir Oliver Lodge, Prof. J. A. Fleming, Prof. W. B. Bottomley, Prof. E. Hull, Dr. J. A. Harker, Prof. Sims Woodhead, and Prof. Silvanus P. Thompson; and their remarks are now published in convenient and cheap form in the little volume before us.

It would be easy to discuss at great length many of the statements made in these addresses, but no useful purpose would be served by doing so here. In the opening address Sir Oliver Lodge made the definite announcement that he had conversed with departed friends "as I could converse through a telephone with anyone in this audience now"; but apparently it is not everyone who is capable of receiving this evidence of survival of existence. The only evidence upon which a man of science cares to base a conclusion is that derived from his own observations; but in spiritual matters conviction takes the place of phenomenal knowledge. The poet and the metaphysician feel that certain thoughts are true, and the ideas thus conceived are to them as definite facts as any inferences depending upon the use of the senses. Such feelings do not admit of objective demonstration, and cannot, therefore, be measured by the standards of natural or physical science. They belong to another world, which the describer of phenomena may contemplate, but is usually unqualified to enter.

It is not to be expected, therefore, that these addresses will bear the severe criticism to which observations and theories are subjected in scientific circles, and serious students of philosophy are not likely to be impressed by most of the evidence adduced of intelligent design in Nature. The somewhat shallow treatment of this profound subject is, we suppose, explained by the popular audiences to which the addresses were delivered. The book is interesting as a declaration of men of science to the reality of religious conviction; but it may be doubted whether any particular significance should be attached to their views upon questions outside the domain of objective truth in which alone they can give authoritative testimony.

A Study of the Circular-arc Bow Girder. By Prof. A. H. Gibson and E. G. Ritchie. Pp. viii+80. (London: Constable and Co., Ltd., 1914.) Price 10*s.* 6*d.* net.

This book treats of the difficult problem of girders forming a circular arc in plan such as are often used to support the balcony of a theatre. The principles on which the general problem may be solved are given in the early portion of the volume, and are amplified from a paper read by Prof. Gibson before the Royal Society of Edinburgh in 1912. Values of the end fixing moments and reactions have been calculated for the more important practical cases, and these values, together with typical bending moment diagrams which are given, will be found useful aids to the designer. The authors have carried out experiments with a view of checking the theoretical investigation, and remarkable agreement is shown. Up to the appearance of this volume there has been no data available for the torsional rigidity of beams of ordinary commercial section, and part of the investigation undertaken by the authors has been the experimental determination of the product CJ (*i.e.*, modulus of rigidity × equivalent polar moment of inertia) for such sections. Mathematical calculations in such cases present insuperable difficulties, and the experimental work given in the book is an interesting and valuable contribution

to our knowledge of materials. A chapter on the general principles of design of the bow-girder is included, and will be of service to the practical designer, to whom a considerable portion of the volume will be sealed on account of necessarily complicated mathematical treatment. The authors may be congratulated on the success with which they have solved a very difficult practical problem.

Spectrum Analysis, applied to Biology and Medicine. By the late Dr. C. A. Macmunn. Pp. xiv + 112. (London: Longmans, Green and Co., 1914.) Price 5*s.* net.

THE late Dr. Macmunn belonged to a class of which British science does well to be proud: the class of men who, notwithstanding the arduousness of their professional labours, find or make time to engage in research. Born in Ireland and educated at Trinity College, Dublin, Macmunn practised medicine for twenty years at Wolverhampton, and during that period published his researches in the application of spectrum analysis to biology and medicine. The present work, as we learn from the preface by Prof. Gamble, was begun and continued between attacks of severe illness and was left in an unrevised state.

Dr. Macmunn was an early worker in the field and deserves the credit of the pioneer. Although no remarkable discovery attended his efforts, he contributed valuable observations on the nature of the various colouring matters both in animals and in plants. He demonstrated that the pigments of not a few animals contain chlorophyll: a demonstration confirmed in certain cases by the discovery of algæ living symbiotically in the tissues of these animals.

Although the professional man of science who specialises in this department of research may not need to consult this work, we welcome it and hope that it may be widely circulated and read, for it is a worthy record of the labours of one who loved research and ensued it with ardour and success.

The Geographic Society of Chicago, Bulletin No. 4. The Weather and Climate of Chicago. By Prof. H. J. Cox and J. H. Armington. Pp. xxv + 375. (Chicago: University of Chicago Press, 1914.) Price 12*s.* net.

MESSRS. COX AND ARMINGTON have made a statistical study of the climate of Chicago of extraordinary detail. The result is valuable as a book of reference, but cannot be described as easy reading, chiefly owing to one hundred and forty-five tables intercalated in the text. Records of temperature extend back to 1830 and of rainfall to 1843, but the series are not homogeneous, there being several changes even in the shorter period 1871 to 1911, which is adopted for normal values. Normals, however, are not regarded as so important as the occurrences of abnormal conditions and rapid variations which render the climate healthful and invigorating—and with a temperature range from −16° to +103° F. there is abundant room for rapid changes. The extremes would be even greater but for the near neighbourhood of Lake Michigan, as is well shown by a study of the lake breezes, and by temperature records at different distances from the shore. The abnormal periods are further considered, not merely locally, but as part of the weather of the whole States, and this aspect is illustrated by reproductions of the daily synoptic charts, unfortunately sometimes so small as to be almost undecipherable. Full use is made of isopleth diagrams for exhibiting hourly variations; a feature with less to recommend it is the replacement of departures from normal temperature by accumulated departures, which are said to be "more vivid"—though it is not self-evident that an "accumulated" departure of +1262° conveys more to the mind than a mean departure of +3½°.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Experiments on Hay Infusions.

DR. BASTIAN'S interesting experiments suggest further considerations, particularly as to the osmotic effects of solutions of different strengths and temperatures. A solution of hay made at a higher temperature will probably be a stronger solution containing more soluble matter, and also more silicate from the glass. A solution kept for a fortnight may evaporate and become more concentrated. Does one concentration produce Zooglœa, and a greater concentration produce spores?

Am I right in thinking that the general effects of increasing concentration are crystallisation, precipitation, an increasingly dense protoplasm, a thickening cell-wall, and cell subdivision? Is free-cell formation another process brought about by increasingly concentrated solutions? Is dilution, and especially dilution with warm water, the necessary osmotic condition for bursting the cell-wall and liberating naked or amœboid forms? Can we explain the phases of an organism in terms of its previous history and present conditions?

Where a change takes place in the population of a pond this may, of course, be due to individual transformations of tadpoles into frogs with rise of temperature, or it may be due to differential rates of increase or death, as when in a dry summer sticklebacks die and frogs survive. It is not quite easy to disentangle the transformation and the survival processes when the organisms are minute.

HUGH RICHARDSON.

Stocksfield-on-Tyne, December 31, 1914.

THE ASCENDING SPIRAL.[1]

MANY years ago the author of this interesting and stimulating book became impressed with the widespread distribution of "spirals" in nature. He has persistently followed the clue in the hope of discovering the significance of this form, which is ever-recurrent, especially in the realm of organisms. Many others have been on

[1] "The Curves of Life. Being an Account of Spiral Formations and their Application to Growth in Nature, to Science and to Art; with Special Reference to the Manuscripts of Leonardo da Vinci." By T. A. Cook. Pp. xxx + 479. (London: Constable and Co., Ltd., 1914.) Price 12*s.* 6*d.* net.

the same track, and the author refers to Sir John Leslie, Canon Moseley, Prof. Goodsir (on whose tomb in Edinburgh a logarithmic spiral was graven), and Mr. A. H. Church, whose studies of phyllotaxis are well known. It is a track to be followed. A symbol, which adorns the cover of the book before us, is held by the author to indicate that Chinese philosophy had adopted the logarithmic spiral as a symbol of growth so long ago as the twelfth century, and several investigators

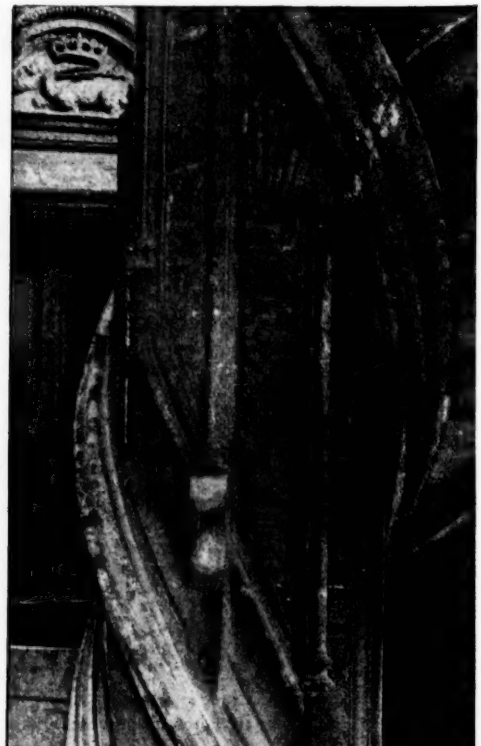

Photo. [*Country Life.*

FIG. 1.—Central shaft of spiral staircase in the wing of Francois I., Château of Blois. From "The Curves of Life."

are still engaged in the twentieth century in the search for that symbol (which we now call a formula). Nor can we forget that Leonardo da Vinci, whose manuscripts the author has studied, was greatly interested in spiral shells—of both living and extinct types, for he was one of the first to appreciate fossils—and used them in his art. Mr. Cook brings forward evidence that the spirals in natural forms made a deep impression on the early artists; and the development of this idea forms a very interesting part of the book, the parallelism worked out between shells and staircases being especially skilful.

Spirals are sometimes seen in the inorganic domain—in whirling dust, in waterspouts, in starry nebulæ, and in certain crystals. But it is in the organic realm that they abound, and Mr. Cook's record of them is impressive. In Foraminifer and Nautilus, Venus Flower Basket and the horns of an antelope, the typical spermatozoon and the egg-capsule of the Port Jackson shark, the umbilical cord and the cochlea of the ear, the arms of a Lamp-shell and the trachea of an insect, the fir-cone and the Turbine shell, the antherozooid of a Cycad and the stem of the honeysuckle, the spiral vessel of a melon and the twisted fibrils of the muscle-fibres of some molluscs, the fruit-stalk of Cyclamen and the inflorescence of Forget-me-not, the leaves on the stems which find in a Fibonacci series the minimum superposition and the maximum exposure, the seaweed Vidalia like a curled shaving and the still more beautiful staircase of the rare *Riella helicophylla* from Algiers, the twisting tendrils of the vine and the horns of a ram, the double spiral of osseous lamellæ in the shaft of long bones and the staircase within the skate's intestine, a Spirochæte and the muscle-fibres of an arteriole! Sometimes their utility is plain, *e.g.*, in assisting in the distribution of seeds and sperms; or in acting like a spring, as in tendrils and tracheæ; or in allowing many structures to be crowded in a small space, as in buds; or in giving architectural strength as in the lamellæ of bones. Mr. Cook points out shrewdly that there is very often a suggestion of growth under resistance, which might be illustrated by the young leaves in a bud, or the spiral fibre of insect tracheæ, or the Venus Flower Basket building itself up on the floor of the Deep Sea; and we like Mr. Schooling's suggestion that the ϕ proportion is an expression of economy of form.

FIG. 2.—The common form of *Voluta vespertilis* (section). From "The Curves of Life."

There is no doubt that Goodsir had a definite expectation that some physiological law of growth or "production" might be discovered by a further study of the recurrent spiral form. We are indebted to Mr. Cook for re-directing attention to this quest.

There are, of course, numberless logarithmic spirals, and Mr. Cook, with assistance from Mr. Mark Barr and Mr. William Schooling, has determined that the form which is most descriptive of those in organic nature is one which he calls the ϕ spiral—one in which the ratio of increase (ϕ) is $(1 \pm \sqrt{5}) \div 2$, or 1·618034, the sum of any two terms being equal to the next term. This kind of spiral is illustrated approximately by many very successful forms of organic growth. We must emphasise the word approximately, for

if the ϕ ratio be that of "perfect growth," it is one towards which vital architecture *tends* rather than one which it reaches. Even the Nautilus shell is only an approximation to it, and this to Mr. Cook is half the charm. For the approximateness reveals the *endeavour*, which arouses our sympathy, while mathematical exactness leaves us dull. Life is like an artist, full of individual variability. "Perfect beauty, like natural growth, implies irregular and subtle variations."

But the ϕ proportion is not only a descriptive formula for natural growth, it shows itself in statues and in the proportions of pictures. It looks as if the secret of one type of successful growth (of course, there are other non-spiral architectural creations) echoed in the artist's expression of the beautiful, and even in our appreciation of it. Perhaps the logarithmic spiral with the Pheidias ratio is an "objective" element in beauty, not merely in the sense that mankind was literally brought up on spirals—in days when spiral phyllotaxis was a problem by no means academic, when the coils of the succulent bulb and the toothsome whelk had an interest much more than æsthetic, when the spiral conch called the tribe to war—and when, for we need not expatiate, the spiral mode of growth became the Swastika symbol of good growth and good luck. We should be inclined to press the point that spiral architecture became prevalent in the evolution of organisms because it was, for certain conditions, particularly fit. It was a successful architectural style, discovered among the unicellulars, and always kept, with the sublime conservatism of vital evolution, *available*, for whatever experiment in internal structure or external form might be demanded or prompted by the exigencies of the situation. The secret was much too good to lose. But Man is conservative as well as Nature, and he began to accumulate pleasant feelings in association with all manner of spirals. But Mr. Cook will not be content with any position of this sort. "If ϕ in some way describes the principle of growth, which is one revelation of the spirit of Nature, would not the artist most in touch with Nature tend to employ that proportion in his work, even though he was not conscious of its exisence?" We confess to wishing to work for a while longer with the hypothesis that the artist uses the ratio of Pheidias because it figures largely in Nature, and thus in Man's upbringing. But Mr. Cook's view is subtler, that Leonardo and the Nautilus exhibited a dominance of the ϕ spiral in their respective masterpieces because they were both artists. We like the spiral shell, and still more the spiral staircase of Blois, not merely because impressionable mankind was brought up on spirals, but because the spiral in question represents one of the inmost experiences of life itself—an endeavour after perfect growth. This seems to be Mr. Cook's view, but we are sceptical.

Mr. Cook has given us a delightful study, eloquent of patience in collecting examples of spirals, of delight in measuring them by the Pheidias rule, and of quiet meditation over "the unspent beauty of surprise" and the worldwide treasures of significant form. The personal note is strong and it is pleasant, but we have sometimes wished, as we read the book, that the author had been more methodical, and less swift to move from one problem to another. For there are many problems. (1) There is the question, which Mr. Cook has in part answered, as to the various architectural types—spiral and otherwise—exhibited by organisms—a question to which Haeckel paid considerable attention long ago in his discussion of "promorphology." (2) There is the question of the varied utility of the spiral, which gives it its survival-value. To answering this Mr. Cook has made some contribution. (3) There is the difficult problem of the forces at work in the genesis of the spiral form, of the physical forces or the properties of matter that determine shape. A preliminary (as it were, aeroplane) survey of this borderland between morphology and physics will be found in Prof. D'Arcy Thompson's brilliant presidential address to Section D of the British Association in 1911; and a paper by the same naturalist on the shapes of eggs (NATURE, vol. lxxviii., pp. 111, 158) is also important. (4) There is the question of the recurrence of the logarithmic spiral in human works of art. Nor should we forget the spider's spiral, the making of which is to be ranked beside building nests and shaping honeycomb, not beside the secretion and moulding of shells. (5) Then there is the problem of why these spirals please us, and are joys for ever. In regard to which it should be carefully noted that there are (*a*) physiological, (*b*) intellectual, and (*c*) imaginative or sympathetic factors in our appreciation of beauty. (*a*) There are shapes that sing, and produce pleasant eurhythmic echoes in our bodies. (*b*) There are shapes which arouse happy associations, and others of which the adaptiveness never fails to please. (*c*) There are others, again, which strike a deeper note, in which we recognise a triumph of life over its materials and difficulties. It is in the contemplation of these achievements that the artist in us is thrilled most deeply, sharing a vicarious triumph.

ICEBERG OBSERVATIONS.[1]

AFTER the loss of the *Titanic* in April, 1912, had directed attention to the dangers from ice in the North Atlantic, the Government and the shipowners concerned chartered the *Scotia* as an experimental ice-observation vessel to cruise to the north of the trade routes. The *Scotia*, fitted with wireless and carrying three investigators and two Marconi operators, was commanded by Captain T. Robertson, her former captain in Bruce's Antarctic expedition. Her work was carried on from March to August, 1913, and proved so useful that the year following she was replaced by a specially-built ice-patrol boat of larger size, and so perhaps more suitable for the work, though it would be

[1] "Ice Observation, Meteorology and Oceanography in the North Atlantic Ocean." Report of the work carried out by the s.s. *Scotia*, 1913. Text, pp. 142. Price 4*s*. 6*d*. Map and Charts. Price 2*s*. 6*d*. (H.M.S.O., 1914.)

difficult to construct a stronger, handier, and better ice-boat than the *Scotia*.

The most generally interesting parts of the detailed reports in this volume are those relating to the detection of icebergs by temperature observations. A Callendar self-recording electrical resistance thermometer held at a depth of 2 ft. below the surface failed to indicate any effect of icebergs on the temperature of the sea. In most cases the passage of the *Scotia* by an iceberg did not correspond with any hump or depression in the temperature curve, and when it did it was impossible to distinguish these from the ordinary variations in the temperature of the sea. As this thermometer, which indicated trustworthily variations of 1/10°, was unaffected by passing icebergs it would be useless in practice to employ such a method of detection. In fact, any variation unrecognisable by an ordinary thermometer would be valueless to the seaman. In his investigation on the *Montcalm* Prof. Barnes came to the conclusion that the real effect of an iceberg on the surrounding water is to warm it slightly. Mr. G. I. Taylor found indications of this, but the effect could not be utilised to detect the presence of bergs on the Newfoundland Banks because the temperature of the sea in that region undergoes small rises in places independent of icebergs. Prof. Barnes found his striking indications of these rises of temperature near inshore, but the *Scotia*, on the other hand, was at work hundreds of miles off the land. It cannot have been that the electrical thermometer of the *Scotia* failed to detect these changes, since check temperatures taken in bucket samples with a thermometer reading to 1/20° gave little or no such indication.

Nor did Mr. D. J. Matthews, the oceanographer on board, find any relation between icebergs and sea temperature. He noticed no rise in temperature in the vicinity of ice, but, on the other hand, found sudden changes in many parts of the North Atlantic where there certainly was no ice within 500 miles.

Similar changes in temperature in the sea far removed from icebergs were noted by the patrol of the U.S.SS. *Chester* and *Birmingham* in 1912.

In fact, all that a sudden fall in surface temperature means is that the ship has entered the polar current and may meet ice if there is any in the neighbourhood. A rise in temperature shows that the chances of ice are less, but not that the ship is safe.

Therefore, unless wireless warnings of the extent of the pack and the position of bergs can be satisfactorily circulated, which is doubtful, ships will have to rely on a careful watch from near the water-line, and the development on the part of the look-out or ice-pilot of that extra sense which all polar navigators gain in time that enables them, as they say, to "smell" the presence of ice. The report ends with a lengthy study of the plankton distribution by Mr. L. R. Crawshay, who reached results similar to those of the physical observers on ice-bearing currents.

R. N. R. B.

LIEUT.-COL. D. D. CUNNINGHAM, F.R.S.

WE recorded last week, with much regret, the death on December 31, in his seventy-second year, at his residence, Tormount, Torquay, of Lieut.-Col. D. D. Cunningham, formerly of the Indian Medical Service.

D. D. Cunningham was born at Prestonpans on September 29, 1843, and was the son of the Rev. W. B. Cunningham, one of the most scholarly of the clergymen who left the Church of Scotland at the Disruption of that year. After leaving school young Cunningham entered the University of Edinburgh, where he graduated with honours in the Faculty of Medicine in 1867. Early in 1868 he joined the Indian Medical Service, and at the Army Medical School, Netley, he took a position as distinguished as that which he had attained in his university.

While Cunningham was at Netley the attention of pathologists in this country was directed to the theories regarding the causation of cholera advanced by Hallier and De Bary, and at the instance of the teaching staff of the Army Medical School the Secretaries of State for War and for India resolved to depute the two young officers who should secure the highest places in the Queen's and the Indian Medical services respectively to learn at first hand the nature and bearing of the theories. Cunningham was the young Indian surgeon thus chosen; the officer of the British Medical Service selected was T. R. Lewis, a man of the same academic standing as Cunningham, but a few years his senior in age, who had graduated with honours in medicine, also in 1867, in the sister university of Aberdeen.

As a result of this selection Cunningham spent some time as an inmate of the house of the Rev. M. J. Berkeley, F.R.S., and acquired a knowledge of the technique employed by that distinguished mycologist. In company with Lewis he paid visits to Hallier and to De Bary, proceeding thereafter to Munich to study under the celebrated Pettenkofer, with whom both young men contracted ties of close personal friendship, which subsisted in the case of Lewis until the latter died, and in the case of Cunningham until the close of Pettenkofer's career.

After this period of study in Germany Lewis and Cunningham left for India, where they arrived in 1869. Immediately on landing both officers were attached for special duty to the department of the Sanitary Commissioner with the Government of India, and commenced partly in collaboration, partly independently, the series of pathological studies the excellence of which led to the selection of Lewis for the Fellowship of the Royal Society, at the age of forty-five, in 1886, and to the election of Cunningham to the Society, at about the same age, in 1889. This period of activity continued for eleven years with the happiest results, and the eloquent testimony borne to Lewis's share in their work, in the pages of NATURE for May 27, 1886, on the occasion of the untimely death of that distinguished pathologist, will better enable workers of the present

generation to realise and appreciate what the work of Lewis and Cunningham implied thirty years ago.

The collaboration of Cunningham with Lewis came to an end in 1879–80 owing to Cunningham's appointment as professor of physiology in the Medical College of Bengal, and to a modification in the organisation of the Sanitary Commissioner's department. The Sanitary Commissioner was in 1880 made also Surgeon-General with the Government of India, and he was only able to retain the services of Lewis in the capacity of secretary to the Sanitary Commissioner.

The diversion of Cunningham's attention from pathological studies was, however, but of short duration. In 1883 Lewis was offered, and accepted, the post of assistant professor of Pathology at Netley, and Cunningham, who had in the interval established his reputation as a teacher of physiology, was asked to undertake, in addition, the duties of secretary to the Sanitary Commissioner. During the remainder of his Indian career Cunningham fulfilled these secretarial duties on behalf of the Government of India in conjunction with his duties as a professor of physiology on behalf of the Government of Bengal. The conditions under which he had to work differed somewhat from those experienced by his predecessor, whose headquarters, when not on tour, were with the Government of India in their summer capital of Simla, whereas, owing to the exigencies of his college appointment, Cunningham's headquarters were in Calcutta. The work accomplished by Cunningham during the next fourteen years, for which period he was in charge of both posts, was unremitting. This, combined with the fact that his duties involved continued residence in the plains, at length undermined what had been a vigorous constitution, and in 1897 Cunningham's health became so seriously impaired that he had to be invalided to Europe, and a year later found it necessary to retire from the service of the Government. After retirement he settled in Torquay, where, in somewhat indifferent health, he spent the rest of his life.

During the period from 1879 to 1897, spent by him in Calcutta, Cunningham took his share of those unofficial duties that fall to public men. He was a member of council of the Asiatic Society of Bengal and a trustee of the Indian Museum. But the work for which he will longest be remembered in Calcutta was that connected with the Zoological Garden, to the committee of management of which he rendered the greatest service, for many years as their secretary and eventually as their president. Largely owing to his energy and knowledge the institution attained the position which it still holds, whether as regards the wealth of its collection or the health of its inmates. His services to this garden are commemorated by a bronze medallion portrait presented by friends when Cunningham retired from public service.

As a teacher of physiology Cunningham was marked by the philosophical breadth of his thought and by the corresponding width of his outlook. His attention, whether in the class-room or the laboratory, was by no means confined to animal physiology; some of his most suggestive allusions and fruitful studies were botanical. In the pathological field Cunningham was not so much the investigator of morbid processes and diseased states as the student of deviations from normal physiological processes and naturally conditioned tissues. Here again, perhaps to some extent as a consequence of his early association with Berkeley and De Bary, Cunningham was as interested in working out the life-history of pathogenic organisms affecting plant tissues as in studying diseases affecting animals or men.

With capacity for research there went, in the case of Cunningham, great powers of observation, thanks to which we are indebted for the existence of notebooks kept with the utmost care during his thirty years' residence in the East. It was to his friends a source of the keenest satisfaction that although Cunningham after retirement was unable to resume the research work of former years, his health improved sufficiently to admit of his exercising his rare literary gift in presenting some at least of the contents of these notebooks to the world.

Cunningham's work in India was recognised by his being made a Companion of the Indian Empire and, during his residence in the East, an Honorary Surgeon to the Viceroy. After his retirement he became an Honorary Physician to the King.

Possessing a manner of ineffable charm and courtesy, kindly and wise in counsel, Cunningham was endeared to all those who had the privilege of his friendship, and to those of the circle, now sadly diminished, who enjoyed that privilege, his loss is irreparable.

SIR OWEN ROBERTS.

BY the death of Sir Owen Roberts, on January 6, in his eightieth year, the cause of technical education in this country has lost one of its most devoted and influential champions. It is nearly half a century (1866) since Sir Owen was appointed Clerk to the Worshipful Company of Clothworkers. At that time the City Companies had fallen into ill-favour. Their immense revenues, it was alleged, had been diverted from their original purpose of trade protection and advancement, and when the movement for improving technical education was started, shortly after the passing of Mr. Forster's Education Act of 1870, longing eyes were cast upon these revenues. It was then that Sir Owen Roberts, in co-operation with Sir William Sawyer, of the Drapers' Company, and Sir John Watson, of the Mercers' Company, conceived the bold policy which at the same time assisted the cause of technical education and saved the companies from the odium into which they had fallen by providing them with a worthy object for their munificence.

The Clothworkers' Company had already taken a leading part in the foundation of the Yorkshire College of Science (which has since become the

University of Leeds), and it had also made large grants towards the establishment of technical schools at Bradford and Huddersfield; but the first great sign of the City Companies' new activity was the constitution of the City and Guilds of London Institute in 1876. It is impossible to trace here the development of this movement, in which Sir Owen Roberts took a leading part. Suffice it to say that, as a result of it, we now have at South Kensington the magnificent Imperial College of Science and Technology, which owes its existence in no small measure to the munificence of the City Companies.

Sir Owen's position as an educational authority was handsomely recognised when he was appointed one of the seven commissioners under the University of London Act, 1898, entrusted with the duty of reconstituting the University. Sir Owen has since confessed that in his opinion the problem of devising an internal university in London is incapable of a satisfactory solution; but he strove with his fellow-commissioners to do the utmost with the materials at their disposal, and for several years he continued loyally to serve the re-constituted university as a member of its Senate. It is probable that he was more completely satisfied with the work which he did at the Royal Society of Arts. One of the chief aims of that royal and ancient institution has, for the last century and a half, been to encourage industry by the application of science and art—precisely the object which Sir Owen had so much at heart. He was elected a member of the Society's council in 1880, and with the briefest break he continued to serve on it until his death. During nearly all this period he acted as Treasurer, and for one year as Chairman of the Council. He had a great grasp of finance, and to his sound advice is due in large measure the prosperity which the society at present enjoys.

Sir Owen will be missed by a very large circle of public and private friends. His genial personality and warm-hearted friendliness ensured him a welcome wherever he went, and he retained to the end a vigorous vitality that might well have been envied by many a man thirty years his junior.

NOTES.

THE council of the Geological Society has this year made the following awards of medals and funds:—Wollaston medal, Prof. T. W. Edgeworth David, C.M.G., F.R.S.; Murchison medal, Prof. W. W. Watts, F.R.S.; Lyell medal, Prof. E. J. Garwood, F.R.S.; Bigsby medal, Mr. H. H. Hayden; Prestwich medal, Prof. Emile Cartailhac (Toulouse); Wollaston Fund, Mr. C. B. Wedd; Murchison Fund, Mr. D. C. Evans; Lyell Fund, Mr. John Parkinson and Dr. L. Moysey; Barlow-Jameson Fund, Mr. J. G. Hamling.

DR. J. SCOTT KELTIE, secretary of the Royal Geographical Society, has been awarded the Cullum gold medal of the American Geographical Society, in appreciation of his services in the advancement of geographical knowledge. Arrangements are being made by the American Geographical Society, through the United States Department of State, for the presentation to be made to Dr. Keltie by the American Ambassador in London.

THE widow of Prof. Henry Draper, of Harvard, the American pioneer in stellar spectroscopy, died recently in New York. Mrs. Draper was herself one of her husband's most capable assistants in the Harvard College Observatory. On his death in 1882 she presented that institution with his eleven-inch telescope and provided the main funds for the preparation of the great "Draper Catalogue," recording the spectra of more than ten thousand stars, as a memorial to her husband. It is announced in the issue of *Science* for December 25 last that Mrs. Draper has, by her will, left large bequests for public purposes. She bequeaths 30,000*l.* to the Harvard College Observatory for the Draper memorial; her husband's photographic plates and apparatus are also bequeathed to the observatory. The sum of 90,000*l.* is given to the New York Public Library, 40,000*l.* for a memorial to Dr. John S. Billings, and 40,000*l.* as a memorial to her father, Courtland Palmer. The income of these funds is to be used for the purchase of books, and an additional trust fund of 10,000*l.* is given for the benefit of the employees of the library. There is also a bequest of 5000*l.* to the Smithsonian Institution, and of 5000*l.* to the laboratory of surgical research of New York University, of the medical department of which Dr. Henry Draper was at one time dean.

SOME indication of the cause of the severe floods which have of late been so prevalent in the Thames Valley and in other parts of the country can be gathered from the summary of rainfall issued in the Weekly Weather Reports of the Meteorological Office. In the five weeks ending January 2 the aggregate rainfall was largely in excess of the average in all parts of the United Kingdom. The greatest excess of rain occurred in the south-east of England, where the fall was 318 per cent. of the average. The next highest percentage is 284, in the east of England, followed by 246 in the midland counties. In the Channel Islands the rainfall was 223 per cent. of the average, and in the south-west of England it was 200 per cent. In all other districts the rainfall was less than double the normal, and in the west of Scotland it was only 131 per cent. of the average.

A SUMMARY of the weather issued by the Meteorological Office for the fifty-two weeks ended January 2 shows the aggregate conditions for 1914. The mean temperature for the year was in excess of the average in all parts of the British Isles. In the east and north-east of England and in the midland counties the mean temperature was 2° above the average, whilst in all other districts except the north and south of Ireland and the Channel Islands the excess amounted to 1°. The south-east of England was the only district with an absolute temperature of 90°, but the thermometer exceeded 80° in all other districts. The lowest temperature was 7° in the east of Scotland. The rainfall for the year was largest in the north of

Scotland, where the amount was 49·31 in., and it was least in the north-east of England with 24·82 in. The only districts with an appreciable deficiency of rain were the west and north of Scotland, where the percentage of the average rainfall was respectively 91 and 94. In the south-east of England the aggregate rainfall was 125 per cent. of the average, which is the highest difference from the normal, in the Channel Islands it was 121 per cent. of the average, in the south-west of England 119, in the south of Ireland, 111, in the midland counties 109, and in the east of England 108 per cent. In no other district was the rainfall more than 104 per cent. of the average. The rainy days were not generally very different from the normal. There was a slight excess of sunshine in the eastern districts, whilst the western districts were mostly in agreement with the average.

A FEW weeks ago we announced with regret the death in Cambridge, on December 9, of Prof. A. van Gehuchten, professor of the anatomy, pathology, and treatment of diseases of the nervous system in the University of Louvain. Sir Clifford Allbutt, in two short communications to the Educational Supplement of the *Times* (January 5) and the *British Medical Journal* (December 26) expressed the grief of many friends at Cambridge, as well as of biologists generally, at the loss which science has sustained by Prof. van Gehuchten's death. To these sources, and an appreciative obituary notice contributed by Dr. F. E. Batten to the latter journal, we are indebted for the following details. In 1887, after a brilliant career as a student under the late Prof. J. B. Carnoy, and in laboratories at Berlin and Frankfurt, van Gehuchten returned, at the age of twenty-six, to Louvain, where he had been appointed instructor in anatomy, especially in the field of neurology, of which subject he became one of the most original investigators and exponents of our time. During twenty-four years the records of his now famous researches into the nervous system appeared in a series of papers in which each challenged the others in interest and importance. His researches dealt especially with the unit of modern neurology—the neuron; with the origin and causes of the motor nerves; the pathology of certain virulent nervous maladies; the phenomena of normal and morbid reflexes; and incidentally but very effectively with the development of methods. It was in 1897 that he began his long and fruitful series of study on methylene-blue staining methods, a report on which he presented to the International Congress of Medicine at Moscow in that year.

A REMARKABLE human skeleton, discovered by Dr. Hans Reck in the Oldoway ravine in German East Africa, is described in the *Antiquary* for January, by Mr. J. Reid Moir. In the layer resting immediately upon the basal basaltic lava, rhinoceros bones were discovered, and in the overlying deposit, that in which the human remains were found, a great number of elephant bones, differing from the present-day African elephant, and a splendid hippopotamus skull were unearthed. Dr. Reck believes that it is impossible to imagine that this skeleton attained its position in the deposit in which it was found otherwise than during its normal accumulation, and that any idea of an artificial grave having been dug into this stratum is untenable. If these facts be accepted, the remains seem to belong to the Pleistocene period. They do not represent a very early or primitive type, and they thus present a close analogy to the celebrated Ipswich man. The obvious conclusion is that man must have been developed at a period much earlier than is generally supposed. But before this startling conclusion is accepted we must have much more precise details of the geological age of the stratum in which the remains were found. A decision on the question may safely be deferred until Dr. Reck's detailed report is available for study.

PROF. FLINDERS PETRIE contributes to *Ancient Egypt*, part i. of 1915, a valuable article on metals in Egypt, in which he brings together all the available information on the use of copper, gold, silver, lead, tin, bronze, and iron. The account of iron is particularly instructive. First, we have the sporadic Iron Age, beginning with the Gerzeh beads and the well-known piece of sheet iron from the pyramid of Khufu at Gizeh. Incidentally, we are told that the supposition that iron might disappear in course of time is a fallacy. A lump of oxide of iron is practically insoluble when buried, and its strong colouring and staining power make it very obvious. The developed Iron Age in Egypt began about 1200 B.C., whereas in Assyria, iron, as a tribute from the Chalybes, dates from 881 B.C. An Ethiopian source for the Egyptian iron may be discarded, as, if it were common there, it would soon have reached Egypt at a very early date; but the Ethiopian slag-heaps are not earlier than the general special culture of that region, which began in the XXVth dynasty, and continued from 700 B.C. onwards. The sources of the European and Euphratean iron would be quite sufficient to account for the general use of iron in Egypt, even apart from the Ethiopian.

THE picture-film entitled "The Escape," exhibited by Messrs. Ruffell, at the Alhambra Theatre, on Tuesday, possesses scientific interest. Apparently an ordinary melodrama of low life, with an exceptionally well-ordered and pictured scenario, it is designed for educational purposes in eugenics. Many of Zola's and de Maupassant's novels and stories might be thus eugenically underlined. The kinematograph has already done good educational work, *e.g.* in botany and general biology, and there is no reason why it should not develop its usefulness all round the educational field. A long view and some imagination are needed if the average person is to draw the eugenic moral from tragedies of everyday life, but a picture-film interspersed with explanatory mottoes, easily remembered, is a real educative force. The drama deals largely with evil conditions imposed by heredity and environment. A connection is made between them and criminal behaviour, operating both in the home and in public. Selfish luxury is exposed as well as selfish brutality, and the effects on the new generation of the nation's men and women are vividly indicated. A picture-play like this should help many to visualise

the scientific reality behind domestic happenings seen daily but ignored.

WE have received a report of a bacteriological examination of the milk supply of Montreal in 1913–14, by Dr. F. C. Harrison and Messrs. A. Savage and W. Sadler. A large number of analyses were carried out on more than 1000 samples, and the averages show that Montreal milk, both in summer and in winter, is of very poor hygienic quality. Various recommendations are made with the view of improving the supply.

IT is shown by Mr. E. Shaw, in the *Victorian Naturalist* for November, 1914, that two supposed species of Australian cockroaches were founded in 1893 on females of a species named in 1869 from males, and representing a genus apart from that to which the two former were assigned.

IN the *American Museum Journal* for December, 1914, Mr. R. C. Andrews records the history of the magnificent collection of whales, porpoises, and dolphins which has recently been brought together in the American Museum, and in the acquisition of which he himself has taken a very large share, having visited whaling-stations in Vancouver, Alaska, Japan, and various Pacific isles, as well as having harpooned white whales during their annual rush up the St. Lawrence. The descriptions of the capture and flensing of the monsters are most vivid, while many of the illustrations are of the greatest interest.

THE Report of the Marine Biological Station at Port Erin for 1914 contains a summary of the investigations carried on at the station during the year. Nearly nine million plaice eggs were dealt with in the fish hatchery, of which number about eight million were successfully hatched and the larvæ liberated at an early stage of development. Experiments in lobster rearing were also carried on. Out of 24,500 eggs placed in the hatching boxes, 1823 larvæ were reared to the fourth or "lobsterling" stage. The regular collection of plankton from Port Erin Bay was continued. Biochemical researches on the nutrition and metabolism of marine animals were carried on by Prof. B. Moore and other workers, and various biological researches were also undertaken.

IN revising the water-beetles of the group typified by the genus Helophorus in the January issue of the *Entomologist's Monthly Magazine* (the first number of the fifty-first volume and of a nominal third series), Dr. D. Sharp takes occasion to express his objection to the practice of prefixing the letter "H" to derivatives from Greek aspirated words, on the ground that the Greeks did not indicate the aspirate by a letter, and arranged the aspirated and silent vowels in a single alphabetical series. To omit the "H" would, however, destroy all clue to the origin of the words, and in certain instances might lead to difficulty; as, for example, if there were a derivative from ὄρος, a mountain, analogous to horizon, from ὅρος, a boundary. In another article Dr. J. Waterston describes two new species of bird-lice (Mallophaga), representing as many genera, from a Colombian toucan.

Tropical Life for December contains a well-illustrated supplement entitled "Panama and Prosperity," with numerous illustrations of tropical products reproduced from excellent photographs. Coco-nut germination, the picking and curing of cacao, the sugar cane industry, lime-growing, and tobacco in Jamaica are among the subjects illustrated, and should prove of value to those interested in tropical vegetation.

IN the *Kew Bulletin*, No. 9, a new oil seed from South America, *Osteophleum platyspermum*, Warb., is described and figured, and an analysis given of the kernel, which contained 55·2 per cent. of fat. Other members of the Myristicaceæ are known to yield yellowish fats containing a large proportion of the glyceride of myristic acid. These seeds, could they be imported in sufficient quantity, would be valuable for commercial purposes.

THE Report of the Botanic Station in the Virgin Islands for 1913–14, just received, shows that in these small islands, as in the larger islands under the jurisdiction of the Imperial Department of Agriculture for the West Indies, important work is being done in the improvement of the cultivated crops. The cotton industry, in particular, is well-fostered, and the usefulness of the station is shown by the large demands received for coco-nuts, coffee plants, bay plants, etc. Special attention is being paid to the coco-nut industry, and its progress will be eagerly watched, especially by those owning land in the islands.

THE Annotated List of Flowering Plants and Ferns of Point Pelee, Ontario, forming Memoir 54 of the Biological Series, Department of Mines, Canada, is a useful compilation, since Mont Pelee lies on a direct line of north and south bird migration. The object of the paper is to throw light on bird migration and also to add to the knowledge of the distribution of the wild plants of Ontario and Michigan. 583 species of plants were noted on the point. On Pelee Island, a large island to the south in Lake Erie, the Kentucky coffee tree and other plants reach their northern limit. It is unfortunate that Mr. Dodge does not summarise his results or draw any conclusions as to the dispersal of the plants by migratory birds.

THE "Fern ledges" of St. John, New Brunswick, form the subject of Memoir 41 of the Geological Survey of Canada, by Dr. M. C. Stopes. These deposits are now recognised as Carboniferous, though formerly described as Devonian, and consist of alternations of sandstones and shales, and it is in the shales that the rich flora of débris occurs. The shales contain impressions of Calamites, Cordaites, etc., and the plants have been for the most part described by Sir William Dawson. A new genus, Pteridospermostrobus is described, the plant being allied to the British Lagenostema, but the preservation is unfortunately very imperfect. The monograph is illustrated by a fine series of plates and useful text figures.

THE annual report of the Philippine Weather Bureau (parts 1 and 2), recently issued under the direction of the Rev. J. Algué, S.J., contains hourly observations

made at the Manila Observatory during the calendar year 1912. There is but little variation in the mean values from year to year, and nothing exceptional occurred during the year in question beyond an increase in seismic activity; *e.g.* the annual departures from the normal of forty-eight years were, for temperature, −0·15°C.; rainfall, +3·8 mm.; it is therefore unnecessary to add to the remarks made in our previous issues. During the fiscal year 1911–12 the earthquakes reported from various parts of the archipelago numbered 230, 90 per cent. above the average. Only five of the shocks were severe; that of July 12, 1911, has been registered all over the world with the characteristics of a "great earthquake." The Manila seismographs recorded 318 disturbances. The relations with other services in the Far East have recently been much improved; the observations are now synchronous, and although not yet simultaneous, the construction of synoptic charts from available data is much more satisfactory.

IN the *Museums Journal* for December Mr. Alan Pollard advocates the practical use of Cartesian co-ordinates for locating objects in a museum or other rectangular room. He suggests that a foot may be a convenient unit for the purpose, and that a rough scale may be sufficient for purposes of localisation, the *centre* of the object being the point specified. As it is necessary to specify which faces of the room are to be taken as co-ordinate planes, the author proposes, the wall containing the door by which the room is entered as plane of (x, z), and the wall to the left of this as plane of (y, z). For a line or plane parallel to one edge or face of the rooms, he proposes to specify numerically the given co-ordinates using letters for the indeterminate ones; for example $(x, 29, z)$ represents a wall 29 ft. from the plane of (x, z).

THERE is a growing tendency among postgraduate students, and indeed mathematical writers generally, to produce papers containing no new ideas, but merely clothing ideas already familiar to readers in slightly different form or notation. As examples we may illustrate the waste of university endowments on students who merely propose to express well-known formulæ of electrostatics or attractions by means of quaternions and elliptic functions. Mr. George Paswell contributes to the Bulletin of the American Mathematical Society for December "An Appeal to Producing Mathematicians" which we hope will be read in very great earnest by all teachers of advanced students and writers of papers. He points out that the profession of civil engineering is teeming with problems awaiting the solutions of a Laplace or a Newton, and he instances the theory of elasticity as requiring the most urgent attention. He further attacks the shallowness of the courses of mathematical instruction given to applied science candidates, and though his strictures apply particularly to America, it is equally true that in Great Britain candidates can obtain University degrees in engineering on work that is scarcely up to intermediate pass standard. A paper by Mr. Sidney Withington on the catenaries of one of the American trolley railways in the Journal of the Franklin Institute for December, 1914, illustrates this point well. The author on page 721 employs the binomial theorem with a reckless waste of neglected terms to prove or rather to fail to prove an obvious geometrical result which he can only accomplish by inserting or omitting a factor 2 from one or other of two quantities to be proved equal, the explanation of this factor being quite different from anything clearly and explicitly stated in the paper. While strongly supporting Mr. Paswell's plea, we greatly regret that he has omitted the subject most urgently requiring research at the present time, viz., aeroplanes. Aeroplane problems are running to waste by the dozen, and they practically never, or at best rarely, figure in mathematical transactions.

THE *Electrician* for December 25, 1914, reproduces the provisional report of the committee of the Physical Society on Nomenclature and Symbols. Some of the most noteworthy features of the report are its proposal to use capitals for the amplitudes, and small letters for the instantaneous values of quantities varying harmonically; its restriction of the termination -ity to specific, and its use of the termination -ance for non-specific, properties. Thus we have the resistance, conductance, and inductance of an electric circuit, but the resistivity, conductivity, and permeability of the material of which it is composed. The term capacity of a condenser is, however, retained, and forms an exception which might be got rid of by the substitution of the word capacitance. In terrestrial magnetism and atmospheric electricity the terminologies are in a chaotic state, and the evil is not likely to be mitigated so long as colourless words like declination and inclination are adopted by theoretical writers for the effects graphically described by the words deviation of the compass and dip respectively. It is much to be desired that the various committees now considering the question of symbols should confer with each other in order if possible to introduce unanimity into their reports (see p. 544).

UNDER the title "Chemistry and Practical Life" has been reprinted an address delivered by Dr. G. T. Beilby before the Chemical Society of the Royal Technical College, Glasgow. Whilst fully recognising the great indebtedness of modern civilised society to science and its discoveries, Dr. Beilby emphasises the enormous debt which had already been incurred to the countless generations of workers who had lived and worked before the advent of chemical science. In reviewing the position of chemical industry in this country, a subject on which Dr. Beilby speaks with authority, it is pointed out that "long after the scientific development of chemical engineering was well under way in Germany, scientific and academic chemists completely ignored the necessity for this new hybrid, the 'chemical engineer,' or openly scoffed at the idea." Too frequently in the colleges of this country "there appears to be an absence of any real conviction that the call for instruction in chemical science with a deliberate view to its application in the

development of the arts and industries is intrinsically sound from the intellectual as well as from the practical point of view." A letter by Mr. C. R. Darling in the Journal of the Society of Arts (December 18) emphasises in a similar way the fact that "if we are to have that co-ordination between the teacher and manufacturer that exists in Germany to the great advantage of both, the teaching of chemistry must not, as at present, be mainly confined to the cloister. We must either introduce courses of instruction in industrial chemistry into our existing colleges and universities, conducted by men of experience, or create new institutions for the purpose. So long as educational authorities regard the possession of a degree as the only criterion of ability, and form their staffs almost exclusively of men who have had no industrial experience, they will never give that effective assistance to the manufacturers which will enable us to hold our own in the sphere of chemical industry."

AMONG the various uses to which oils are put is their employment by electrical engineers for the insulation of oil-immersed transformers and for surrounding the breaking contacts of high-tension switches. Special qualities of oil are necessary and a good deal of research has been going on as to the selection and testing of suitable oils for these purposes. A quantity of information has been collected by a research subcommittee of the Institution of Electrical Engineers, and is embodied in a report just issued. The chief troubles are the deterioration of the oil by the gradual formation of sludge and the lowering of its quality as a dielectric by the absorption of moisture. This sludge now appears to be due to the formation of complex organic acids, dehydrogenated hydrocarbons, and oxidised resinous asphaltones of the mineral oil originally used. The formation of these compounds is accelerated by increase of temperature, and for testing purposes they can be rapidly produced by exposing the oil to ozone. The effect of sludging, although impeding the required circulation of oil in a transformer, does not affect its dielectric quality so much as the absorption of moisture, and this is so serious that the presence of a small percentage of water in the oil is more easily detected by electrical tests than by purely chemical methods.

HITHERTO the manufacture of the well-known antiseptic, thymol, has been practically confined to Germany, notwithstanding the fact that ajowan seeds, the oil from which is almost the sole source of commercial thymol, are grown on a large scale only in India, which has thus been supplying Germany with the raw material of a valuable industry. No further supplies of thymol being forthcoming from Germany owing to the war, the price had increased almost eight-fold by September last, and is even now 21*s.* 6*d.* per lb., as against 5*s.* per lb. before the war. There is every reason why the United Kingdom should now become the chief centre of the manufacture of thymol. The manufacturing process is quite simple, and ample supplies of ajowan seed are available in India. The Imperial Institute, which has devoted attention to this subject, has now made inquiries in India, and is prepared to put intending British manufacturers of thymol in touch with Indian exporters of the seed. Fortunately, too, a British possession can provide a substitute for thymol if such be required. This substance is carvacrol, which is obtained from oils derived from a variety of plants, but particularly from the origanum of Cyprus. At the instance of the Imperial Institute this Cyprus origanum oil is already being produced in commercial quantities from wild plants in Cyprus, and in 1913 was exported thence to the United Kingdom to the value of 980*l.* It is believed that the plant can be cultivated profitably and on a large scale in Cyprus, and experiments in this direction are understood to have been begun.

THE first report of the Board of Trade Committee on bulkheads and water-tight compartments, presided over by Sir Archibald Denny, has now been issued, and forms the subject of the leading article in *Engineering* for January 8. The committee has now been at work for nearly two and a half years, and the first report deals with foreign-going steamers carrying more than twelve passengers. It is not possible even to mention all the points covered by this comprehensive report, but we note that the committee has given a clearly defined method for the construction of flooding curves and tables. Full calculations were made for several actual vessels of widely different types, and from these, together with the general laws governing flooding calculations, a method of preparing flooding curves from simple data was devised. The method was tested by applying it to a number of actual vessels, and comparing the results with those given by full flooding calculations for the same vessels. The Committee is right in claiming that the formulation and enforcement of rules governing subdivision is a contribution of the utmost importance to the subject of safety of life at sea.

WE have received an interesting pamphlet from the Bonecourt Waste Heat Boiler Co., Ltd., of Parliament Mansions, Westminster, in which is described a method of raising steam for power, heating, or other purposes by utilising the heat carried away in the products of combustion of internal-combustion engines and metallurgical furnaces. In general, the exhaust gases from an internal-combustion engine contain from 30 to 45 per cent. of the total heat available in the fuel supply, and these gases leave the engine at a fairly high temperature. In the Bonecourt system the exhaust gases from the engine are passed through internal tubes in a small steam boiler. At full engine load it is claimed that from 3 to 3·5 lb. of water can be evaporated from and at 100° C. per hour per brake-horse-power of the engine, with no additional cost for fuel. In other types of boiler made by the firm, both fuel firing in an ordinary grate and heating by exhaust gases are combined. Small tubes take the products of combustion from the coal-fired grate and separate larger tubes in the same boiler receive the engine exhaust gases. A boiler 7 ft. in diameter by 6 ft. long would be

suitable for a 500 brake-horse-power gas engine, and would evaporate 1500 lb. of water an hour from and at 100° C. from the heat in the exhaust gases alone. Alternatively it would evaporate the same quantity when fired with coal alone, and if worked simultaneously by both methods, the evaporation would be about 3000 lb. an hour from and at 100° C. A large increase in efficiency is claimed by application of the system to open-hearth furnaces.

THE forty-second annual issue, that for 1915, of "Willing's Press Guide and Advertisers' Directory and Handbook" has been received. This yearly book of reference provides a concise and comprehensive index to the Press of the United Kingdom, a list of telegraphic news and reporting agencies, lists of the principal Colonial and foreign journals, and a variety of general information. A classified index of periodicals will prove of special interest to librarians, who, under such titles as "Chemical Science," "Geology," "Astronomy," "Philosophy," will find lists of magazines and journals devoted to different branches of science. The price of this useful "guide" is 1s.

OUR ASTRONOMICAL COLUMN.

FIREBALLS IN JANUARY.—Though January is by no means a month presenting special meteoric activity, it has furnished quite an unusual number of large fireballs. An analysis of the dates appears to show that the following periods are rather strikingly indicated:—

		Principal Radiants.		
Jan.	1–4	230°+52°		
	9–13	57°−12°	120° 0°	133°+21°
	14–19	110°+23°	130°+33°	130°+48°
	25–28	132°+31°	160°+58°	332°+57°

The January fireballs deserve more careful observation and inquiry. There are evidently some rich showers involved, but it is very difficult from the limited state of our knowledge, to single out the richest systems from the large number which apparently supply our January meteors. Apart from the several radiants mentioned above, there are many others fairly well defined in Aries, Taurus, Perseus, Leo, Virgo, Gemini, and Ursa Major. The data already collected appear to prove that the prevalence of large meteors is due rather to a considerable number of showers than to the special activity of two or three, but the investigation can be carried still further when additional materials have accumulated.

THE CAPTURE THEORY OF SATELLITES.—Prof. T. J. J. See's volume entitled "Researches on the Evolution of the Stellar Systems" (vol. ii., "The Capture Theory"), is discussed by Dr. A. C. D. Crommelin in the current number of *Scientia* (vol. xvii., 1915.) Prof. See's contention is that the planets and satellites were independent of the solar system, and have never been evolved from what we consider their primaries, but that they have been captured from outside and made to conform to their present orbits under the secular action of a resisting medium. Dr. Crommelin holds to the view that the matter embodied in the planets was always a part of the solar system, but spread out in the form of huge dust clouds, which finally condensed round certain centres. It is in support of this view that the present article was written, and he brings forth many lines of argument which help to strengthen his view. Dr. Crommelin states that his conclusions do not imply any want of respect for Prof. See's contributions to astronomical theory, for "his suggestions are always stimulating and ultimately help on the attainment of the truth." The new light that the study of the spectroscopic binaries has shed on the question calls nevertheless for a modification of his views.

OBSERVATIONS OF THE MOON.—Prof. W. H. Pickering, in the November number of *Popular Astronomy* (vol. xxii., No. 9, 1914) described some interesting observations on the lunar crater Aristillus, and incidentally made some general statements which no doubt have attracted attention. He points out that nearly everyone who looks at the moon through a telescope confines his attention to those regions near the terminator because they furnish "striking views, are easily identified, and because what is seen is easy to understand." It is for this reason, he says, that the impression that the moon is lifeless has so long maintained its existence. According to him the only time when the moon is really interesting is when its surface is viewed far away from the terminator, that is, during the lunar summer time, for then changes are taking place, changes which are "conspicuous all over the surface to any who will take the trouble to watch and to study them carefully." Here, he suggests, is the opportunity for the amateur to come in, to make his observations and drawings with care, to record the times, compute the corresponding co-longitudes, and to publish his results. The necessary observations do not require the highest grade of seeing nor the largest telescopes. Close observation has led Prof. Pickering to conclude that the moon is very far from being a dead planet, and he has advocated the existence of vegetation on the moon for more than twenty years; he hopes by means of the above assistance that his idea will gain ground, and that the text-books of twenty years hence will not contain the statement that "the moon is without air, water, or vegetation."

COMPANION TO "THE OBSERVATORY" FOR 1915.—The Companion to *The Observatory* for the present year has just come to hand, and its contents are familiar to astronomers, both professional and amateur. The substance of the matter and its arrangement follows for the most part on the lines of former issues. One important alteration is the page devoted to meteor radiants. This year the principal radiant is given for each night during the year, as well as the average hourly number of meteors visible on a clear moonless night. This information is supplied by Mr. W. F. Denning from observations made between 1866 and 1914. Only two eclipses will occur during the year, and these are both annular eclipses of the sun; neither will be visible in Europe.

THE METEOR-FALL OF ENSISHEIM (1492).—A reprint from the Journal of the Royal Astronomical Society of Canada (September-October, 1914) contains some interesting historical references to the meteor-fall of Ensisheim, which occurred in Alsace in 1492. These notes have been brought together by Dr. C. A. Chant in the hope of clearing up several discrepancies between different authorities. According to Wulfing's work on meteorites in collections and literature, sixty-five museums are supposed to possess portions of this meteorite, the original weight being 127 kg. (279 lb.), of which 70·4 kg. have been located. Ensisheim is the fortunate possessor of 54·8 kg., which is preserved in the town hall.

CHEMICAL TESTS AND STANDARDS.

AS is well known, the Bureau of Standards of the U.S. Department of Commerce[1] issues from time to time circulars and technological or scientific papers upon various matters which have come before it for investigation. Among a budget of these publications received recently are papers dealing with the questions indicated below.

In Technologic Paper No. 31, Mr. E. T. Montgomery describes experiments made with "Some leadless borosilicate glazes maturing at about 1100° C." In ceramic practice glazes containing lead have certain advantages, but are often potentially poisonous. The object of the experiments was to make a general comparison between lead glazes and leadless glazes for white ware and china at a firing temperature of about 1100° to 1120° C. Seger's work on leadless glazes was taken as the basis. The author concludes that both kinds have special faults and special virtues, but it is not likely that any leadless glaze will be found "which will exactly duplicate the many excellent properties" of glaze containing lead as an ingredient.

Paper No. 33 describes a method of determining the carbonic acid, obtained from the combustion of carbon in iron, by converting it into barium carbonate and titrating this salt. This avoids certain errors to which the use of potash bulbs or soda-lime tubes for weighing the carbonic acid is liable. The principle of the process is well known; the point of the paper lies in the details given for obtaining accurate and fairly rapid results.

In Paper No. 35 Mr. L. G. Wesson explains a "combustion method for the direct determination of rubber." It consists in converting the rubber into a nitrosite, which is then dissolved out with acetone, and a combustion analysis made upon an aliquot part of the solution after expulsion of the solvent. The process promises to be a useful one.

The "Scientific Paper" (No. 221) is a discussion of the "influence of atmospheric conditions in the testing of sugar." During the operations of clarifying and filtering solutions of sugar for polarimetric examination, the liquids, if not kept covered, lose water by evaporation. The concentration of the sugar is thus increased, and the polarisation-value rendered too high. The magnitude of this effect, and the conditions modifying it, have been investigated by the authors of the paper. By keeping the liquids covered during the operations practically all increase in the polarisation-value may be prevented.

Of the "Circulars" in question one (No. 16) is a small pamphlet which describes the testing of hydrometers as carried out by the Bureau of Standards, and gives instructions with a view of promoting uniformity in the construction and verification of these instruments. The other (No. 44, "Polarimetry") treats of the principles which underlie the construction and use of the polariscope and the analysis of sugars. It is written from the point of view of the standards department, and deals at some length with the different systems, scales, and sources of illumination employed in modern polarimetry. This publication is distinctly of value both to polariscope makers and to sugar analysts.

[1] Bureau of Standards. Technologic Papers, Nos. 31, 33, 35: Scientific Paper No. 221; Circulars Nos. 16, 44.

WAR AND THE RACE.

THE Manchester Statistical Society has printed an eloquent address by Dr. C. W. Saleeby, "The Longest Price of War." The thesis is the old, but politically ignored, result of war in "reversed selection." Quoting Michelet's epigram that the campaigns of Napoleon lopped a cubit from the stature of the French, and Prof. J. A. Thomson's observation that not even the discoveries of Pasteur could restore the physique which the victories of Napoleon's armies had destroyed, Dr. Saleeby notes the small size of the present-day French soldier, as remarked by many observers. To-day, for our own forces, "the brave, the vigorous, the healthy, the patriotic are taken, and the others left. . . . The rejected recruits recruit the race." The whole question is one which statisticians should investigate in special reference to the present war. Dr. Starr Jordan's study, "The Human Harvest," and the late J. Novikow's "Darwinisme Sociale," are the best of a meagre list of popular expositions of the thesis, of which the decay of the Roman Empire is the classic type. Speeck estimated that of every hundred thousand Romans, eighty thousand were slain. "Vir" thus gave place to "homo"; "the Roman Empire perished," says Seeley, "for want of men."

No scientific mind wishes to eulogise war, in the German fashion, which depends for its argument on the primitive athletic form of war, whereas war of to-day is simply peace riddled with casualties. Darwin's famous sentences refer only to a more or less imaginary conscript army in a country which is always at war—"in every country in which a large standing army is kept up, the finest young men are taken by the conscription or are enlisted. They are thus exposed to early death during war, are often tempted into vice, and are prevented from marrying during the prime of life. On the other hand, the shorter and feebler men, with poor constitutions, are left at home, and consequently have a much better chance of marrying and propagating their kind." It seems a fairly obvious inference that the dysgenic results of modern warfare remain to be proved. The deliberate sacrifice of life by exploiting the mass-formation is a special case needing investigation. The whole subject calls for investigation; until this is carried out, nothing is at all clear either for or against the biological effects of war.

STANDARDISATION OF ELECTROTECHNICAL SYMBOLS.

THE International Electrotechnical Commission has recently issued its report (Publication 27[1]) upon international symbols in electrotechnics. In the preface to the report, it is pointed out that the subject of international agreement in regard to symbols employed in electrotechnics was first brought before the International Electrotechnical Commission at its meeting in London in 1908. In Brussels, in 1910, a few general rules, together with a certain number of symbols, were adopted for circulation to the various national committees. The question of international agreement in regard to the symbols for the algebraic representation of Ohm's law was briefly mentioned, with the result that the following year, at Cologne, certain definite proposals were made by Dr. E. Budde, president of the German committee, which culminated in international agreement being reached in this important matter at the plenary meeting of the commission held in Turin in September, 1911. At the latter meeting a number of other proposals were provisionally adopted, and a special committee was instituted to continue the work and draw up further proposals to be placed before the national committees for their consideration. At the plenary meeting of the Commission held in September, 1913, at which twenty-

[1] London: Published for the Commission by Waterlow and Sons, Ltd., and to be obtained from the General Secretary, 28 Victoria Street, Westminster, S.W. Price 2s. 1d. post free.

four nations were represented, the final recommendations were ratified as given in the report here reprinted. An article on the proceedings of that meeting appeared in NATURE of September 25, 1913 (vol xcii., p. 109).

Introductory Remarks on the Standardisation of Symbols.

In so far as electrotechnics alone are concerned, it would seem possible to standardise symbols, and the following principles have served as the basis of the work of the special committee in the attainment of this object:—

The symbols must be clearly distinguishable one from another when writing with a pen on paper, with chalk on a blackboard, or with a typewriter. In the printed text, it is advisable to use a different type for the symbols from that of the text. It is desirable also that in ordinary handwriting, one should not be obliged to add distinctive signs to symbols to specify the type to be employed. It should be possible to spell out the symbols when writing them on the blackboard. Finally, preference should be given to those symbols already in common use. From this it will be seen that it is impossible to make a distinction, in ordinary handwriting, between Roman letters and italics, and that small roundhand letters, being too difficult to differentiate from the above, cannot be used. It is generally agreed to abandon Gothic type, as requiring too long a time in writing. Finally, many of the Greek capitals are identical with Roman capitals. Taking the above points into account, there remain about one hundred symbols available in Roman, Script, and Greek type, of which several are already used for mathematical symbols and which are necessary for the purposes of the electrician. A list of symbols most frequently needed in electrotechnics is appended herewith. Taking into account certain symbols which are occasionally made use of, it is obvious that there will be none left for purely physical or mechanical quantities. Thus, in the same formula, electrotechnical symbols may occur in conjunction with other symbols used in mechanics and physics generally; this is especially the case in equations containing mass, moment of inertia, speed, density, temperature, quantity of heat, etc. The I.E.C. recommends, therefore, that in such cases, for physical and mechanical quantities, the symbol habitually used by physicists and mechanical engineers should be employed, if this symbol does not already exist in the formula as an electrotechnical symbol. If, on the contrary, it already exists in the formula, it is desirable that it be accompanied by a distinctive sign or that the notation be changed.

Rules for Quantities.

(*a*) Instantaneous values of electrical quantities which vary with the time to be represented by small letters. In case of ambiguity, they may be followed by the subscript "t."

(*b*) Virtual or constant values of electrical quantities to be represented by capital letters.

(*c*) Maximum values of periodic electrical and magnetic quantities to be represented by capital letters followed by the subscript "m."

(*d*) In cases where it is desirable to distinguish between magnetic and electric quantities, constant or variable, magnetic quantities to be represented by capital letters of either script, heavy-faced, or any special type. Script letters to be only employed for magnetic quantities.

(*e*) Angles to be represented by small Greek letters.

(*f*) Dimensionless and specific quantities to be represented, wherever possible, by small Greek letters.

TABLES OF SYMBOLS ADOPTED.

I.—*Quantities.*

NAME OF QUANTITY	SYMBOL	Symbols recommended for the case in which the principal symbol is not suitable
1. Length	l	In dimensional equations the capital letters $L, M, T,$ are to be employed
2. Mas	m	
3. Time	t	
4. Angles	$a, \beta, \gamma \ldots$	
5. Acceleration of gravity	g	
6. Work	A	W
7. Energy	W	U
8. Power	P	*
9. Efficiency	η	
10. Number of turns in unit of time	n	
11. Temperature Centigrade	t	θ ϑ
12. Temperature absolute	T	(-)
13. Period	T	
14. $2\pi/T$	ω	
15. Frequency	f	ν †
16. Phase displacement	ϕ	
17. Electromotive force	E	
18. Current	I	
19. Resistance	R	
20. Resistivity	ρ	
21. Conductance	G	‡
22. Quantity of electricity	Q	
23. Flux-density, electrostatic	D	
24. Capacity	C	
25. Dielectric constant	ϵ	
26. Self-inductance	L	$\mathfrak{L}$
27. Mutual inductance	M	$\mathfrak{M}$
28. Reactance	X	$\mathfrak{X}$
29. Impedance	Z	$\mathfrak{Z}$
30. Reluctance	S	$\mathfrak{R}$
31. Magnetic flux	Φ	$\mathfrak{F}$
32. Flux-density, magnetic	B	$\mathfrak{B}$
33. Magnetic field	H	$\mathfrak{H}$
34. Intensity of magnetisation	J	$\mathfrak{J}$
35. Permeability	μ	
36. Susceptibility	κ	

Script, heavy-faced, or special type

* A symbol for the second column is to be supplied by the Austrian and German Committees jointly and inserted without further discussion by the I.E.C.

† This symbol will be omitted if the Austrian and German Committees agree to do so.

‡ A symbol for the second column is to be supplied by the Austrian and German Committees jointly and inserted without further discussion by the I.E.C.

The German delegate made a reservation in regard to the symbols 13, 14, 20, 23, 25, 27 to 31, which are

not so far accepted in Germany, but did not oppose the adoption of these symbols by the I.E.C.

II.—*Units. Signs for Names of Units.*

Signs for names of electrical units to be employed only after numerical values:—

Name of Unit	Sign
1. Ampere	A
2. Volt	V
3. Ohm	*
4. Coulomb	C
5. Joule	J
6. Watt	W
7. Farad	F
8. Henry	H
9. Volt-coulomb	VC
10. Watt-hour	Wh
11. Volt-ampere	VA
12. Ampere-hour	Ah
13. Milliampere	mA
14. Kilowatt.	kW
15. Kilovolt-ampere	kVA
19. Kilowatt-hour.	kWh

m	sign for milli-	μ	sign for micro- or micr-
k	sign for kilo-	M	sign for mega- or meg-

* As a sign for the ohm, one of the two letters O or Ω is provisionally recommended. The letter Ω should no longer be used for megohm.

III.—*Mathematical Symbols and Rules.*

Name	Symbol	Symbols recommended for the case in which the principal symbol is not suitable
Total differential	d	*d*
Partial differential	∂	
Base of Napierian logarithms	e	*e*
Imaginary $\sqrt{-1}$	i	j
Ratio of circumference to diameter	π	
Summation	Σ	
Summation, integral	∫	

1. Ordinary numerals as exponentials shall exclusively be used to represent powers. (In consequence, it is desirable that the expression $\sin^{-1}x$, $\tan^{-1}x$, employed in certain countries be expressed by arc $\sin x$, arc $\tan x$.)

2. The comma and the full-stop shall be employed for separating the decimals according to the custom of the country but the separation between any three digits constituting a whole number shall be indicated by a space and not by a full-stop or a comma (1 000 000).

3. For the multiplication of numbers and geometric quantities, indicated by two letters, it is recommended to use the sign ×, and the full-stop only when there is no possible ambiguity.

4. To indicate division in a formula, it is recommended that the horizontal bar or the colon be employed. Nevertheless the oblique line may be used when there is no possibility of ambiguity; when necessary, ordinary brackets ( ), square brackets [ ], and braces { } may be employed to obtain clearness.

IV.—*Abbreviations for Weights and Measures.*

Length:—m; km; dm; cm; mm; μ=0·001 mm.
Surface:—a; ha; m²; km²; dm²; cm² mm².
Volume:—l; hl; dl; cl; ml; m³; km³; dm³; cm³; mm³.
Mass:—g; t; kg; dg; cg; mg.

V.—Name for Electrical Unit.

The I.E.C. will recommend to the International Congress of the Applications of Electricity, to be held in San Francisco in 1915, the adoption of the name "Siemens" for the unit of conductance.

GERMAN METHODS IN COMMERCE.

A PAPER on the organised methods employed by Germany in commerce, prepared by Sir William Ramsay for the Institute of Industry and Commerce, was referred to in a paragraph in NATURE of December 24 (p. 457). By permission of the institute, the article is here reprinted in full.

It has not been generally known that in commerce, as in war, the methods employed by Germany have been completely organised for many years. Instead of looking on commerce as an arrangement for mutual benefit, the German nation has regarded it as a war, And just as in the present war all methods of attack are regarded by the military advisers of Germany as legitimate, so we are slowly awaking to the knowledge that German commercial and industrial methods have for years been aggressive. The war in which we are now engaged is, indeed, a war for the liberation of nations from commercial and industrial brutality, as well as for their deliverance from an attempted enslavement to German "Kultur," as exemplified by the practices of their army.

At the annual meeting of the Society of Chemical Industry in 1903 I pointed out that the German military organisation had its counterpart in their commercial organisation; that there exists an Imperial Council whose proceedings are kept quiet, but which takes into consideration all obtainable statistics, and as far as possible legislates, or endeavours to legislate, on the basis of these statistics. Where fiscal duties are found to be required, such a council puts them on; where there is an advantage in taking them off, they are removed. Where cheap transit is possible they give it; for the railways are the property of the State. I then said:—"Is it to be expected that any country can fight such a combination as that without adopting, at all events, something of their methods, or without studying their methods, and without combining together, if not to imitate them, at least to thwart them? There is a military campaign against us, and we must defend ourselves."

The competition in the colour trade, for instance, has almost prohibited the manufacture of dyes in England. In Germany the management is in the hands of well-trained men, who, aided by an efficient staff of engineers and chemists, are continually engaged on the problems of utilising any discovery made in their own laboratories or elsewhere, and making it commercial, whether by securing cheap raw material, cheapening the process of manufacture, or creating a public demand for the object to be manufactured. Agencies are maintained all over the world whereby the article is introduced to the notice of foreign purchasers; and an extensive credit system is encouraged. All this is legitimate; but the maintenance of a trained legal staff, not merely to advise as to the validity of patents, but to advise whether the infringement of

another's patent is likely to be successful, and whether it may not be possible, by infringing a patent, so to saddle an opponent with legal expenses as to break his competition, is not easily defensible. Fair competition between individuals lies at the bottom of all trade; unfair competition, backed by all the resources of the State, is what we have had to face with Germany.

We have recently had brought to our notice German methods applied to the shipping industry, and the Australians have been pointing out that the control of the "base metal market" is almost entirely in German hands.

It is necessary to go further; just as the German State has shown itself to be no respecter of treaties, just as the leaders of the German army have revealed themselves as breakers of every humane law, treacherous and deceitful, so long as they think they can gain their ends, so it is foolish not to be warned that the German nation as a whole, is completely unworthy of trust; that commercial agreements are regarded by members of that nation as binding only so long as some advantage is to be gained by keeping to them, and that dishonesty is excusable if only it appears to lead to German prosperity. For there is a sort of debased patriotism in the average German mind, "Deutschland, Deutschland über alles, über alles in der Welt," no matter how the supremacy of "Deutschland" is secured.

We were shocked at the beginning of the war by the disregard towards treaties displayed by our opponents; we were amazed at the treatment of Belgian non-combatants; and we are slowly realising that every trick, from firing on the Red Cross to the false display of the white flag of surrender, is made use of by the enemy, and not, be it observed, by individual groups of our opponents, but by command from high quarters. We are slowly and incredulously awakening to the knowledge that German commercial tricks are on a par with their tricks in war: that the whole nation is infected by the microbe of dishonour and dishonesty.

Of course, there are honest men among our opponents; from time to time we read of kind acts to our wounded; and from a lifelong experience of Germany and the Germans I have no hesitation in stating there are Germans as kindly, as honest, and as upright as there are among ourselves, the French, the Americans, and among the inhabitants of all other nations. That is not the point. What we have to face is a nation organised for a policy of dishonesty; and a nation which, as a nation, approves of that policy. Moreover, this nation believes that the policy of dishonesty is likely to be a successful one, and it has the will, and believed itself to have the power, to enforce this policy on the whole world. Conscientious Germans have been impressed more by the end than by the means adopted to gain that end: the prosperity of their "Vaterland."

I conceive that the main purpose of the Institute of Industry and Commerce is to take counsel and evolve some means for combating this attack. Just as it is clear that peace can never be declared until the chance of another Teutonic outburst is made impossible, by the total disbandment of the German army, so it must be evident that the commercial system of Germany cannot be allowed to continue. It is probable that it is better to make a beginning by an alliance of science, industry, and commerce, such as the institute contemplates; but it will be necessary, if the future German State is allowed to retain the power of waging an industrial war, to combat it by the action of the organised British nation, that is, by the State. Once that conquest is achieved, however, we should do well to remember that commerce should be co-operative and not competitive; that it is to our interest not only that we ourselves should prosper, but that others should also prosper; that, indeed, our own prosperity is bound up in the prosperity of our fellow-creatures.

WILLIAM RAMSAY.

STATE AID FOR SCIENCE.[1]

Introductory.

ELEMENTARY education and the training of teachers for work in elementary schools have been the object of State solicitude for the past eighty years. Increasing sums of money have been devoted to these two purposes; rules and regulations in rich variety have been framed for the proper disposal of this money, and some of the ablest and most energetic administrators have spent their lives in the endeavour to carry them out; a vast system of officials and organisations has arisen to see that no possible flaw or fault remains in the effective distribution of the sums annually voted by the State; and yet the general consensus of opinion among those best qualified to judge is that the results achieved are very poor, that they are transient in effect and occasionally even harmful rather than beneficial. Gigantic efforts have been and are being made, yet the results are plainly incommensurate with the outlay; very few indeed being satisfied that the State and the locality are getting money's worth for their expenditure.

This then being the present position as regards the problem of elementary education let us now see how far the same position is true in regard to the small portion of the State's annual expenditure on education of all types and degrees which is specifically earmarked for the promotion of science teaching, scientific training, and research. It may perhaps turn out to be true that the ineffectiveness of much of our educational system is due to the absence of the scientific spirit among our administrators and teachers, to lack of definite knowledge of the capabilities of the child mind, and neglect of the conclusions which science, if properly studied, could have supplied.

Taking as the basis of our investigations the various sums voted by the State for the promotion of science during the past sixty years, we can from the variations in the amounts, and in the particular objects for which these amounts were granted, observe how the encouragement given to science has fluctuated. For this purpose the Estimates annually presented to Parliament are the most trustworthy guide—a guide who, however, frequently leads one astray.

The task of following any particular item of the Vote from year to year is rendered difficult from the various reorganisations and rearrangements occasioned by the changes made from time to time in the organisation of the various offices, as, for example, when the control of science instruction in Scotland was transferred to the Scottish Education Department in 1897–8, and that for Ireland in 1899–1900 to the Board of Agriculture and Technical Instruction. Nor is this the only source of confusion. Sub-heads dealing with science are sometimes kept separate from and sometimes amalgamated with those relating to art, so that it is not possible to say with certainty whether a particular form of aid has increased, diminished, or disappeared.

This difficulty becomes accentuated in the year 1900, when the Science and Art Department became amalgamated with the Education Department, and the two started anew on their official career as the Board of Education. In subsequent Estimates votes were

[1] Abridged from a paper read before Section L of the British Association at Melbourne, by C. A. Buckmaster.

rearranged, amalgamated, or split up until their history can no longer be followed with accuracy.

It will thus be seen that the determination of the exact amount contributed by the State for the furtherance of science is not altogether an easy matter. Moreover it cannot be settled by turning to Class IV. of the Estimates, which deals with the amount allotted for education, science, and art—three subjects probably entirely distinct in the official mind. For in Class II. of the Estimates dealing with public offices there will be found under the head of the Board of Agriculture items for agricultural education and for advances to societies for experimental purposes and for research. This is only one example to show that the money voted annually for education, science, and art does not represent the total of the State's assistance either to education or to science. We need not inquire on the present occasion if it is more complete in regard to art.

Again, from time to time the State, goaded into action by outside pressure, grants sums of money for specific scientific inquiries, such as the 1000*l.* allotted in 1873 and following years to the Sub-Wealden Exploration, the 15,000*l.* granted for observing the transit of Venus in 1882, the annual grants for successive years of varying sums from 2000*l.* to 5000*l.* for the Deep-Sea Exploring Expedition in 1877-87. The recent National Antarctic Expedition also received the substantial help of 45,000*l.* The International Geodetic Conference was aided for a number of years, and so also was, and is, the North Sea Fisheries inquiry. These are genuine examples of the aid given by the State for science purposes, but they are from their very nature variable in amount, and not assigned as part of a definite policy of encouraging systematic scientific research as a continuous and necessary part of national organisation. They owe their existence to external forces, and if these were withdrawn or lessened they would disappear.

The grants of this character are generally, but not universally, to be found under Class IX. of the Estimates labelled "Miscellaneous or Temporary."

Another series of grants are to be found under the heading "Public Buildings," where the sums voted for the Natural History Museum, the Royal College of Science, the Edinburgh Industrial Museum, the National Physical Laboratory, the Edinburgh Observatory, and other buildings may from time to time be discovered and their progress followed by noting the sums annually voted towards their commencement, continuation, and completion. These sums also are not voted as part of a settled, thought-out scheme of scientific equipment for the nation, but are granted more or less piecemeal, according to the pressure which can be brought to bear to get a particular vote included in the Estimates.

Class IV. (Education, Science, and Art) does not therefore, include anything like all the State aid given to science, nor does it include all that is given for educational purposes. The War Office Vote includes large sums spent, not merely on the technical training of officers, but also on the general elementary education of the rank and file of the Army, and of their children, both in day schools and in evening classes. Similarly, the Admiralty Vote includes the sums spent on the educational institutions at Osborne and Dartmouth, and less important places. The Vote for educational purposes in the Army Estimates for 1914-15 amounts to more than a quarter of a million, while that for the Navy is slightly less than this amount. Probably a greater proportion of the Navy Vote is spent on science instruction than is the case with the Army. This might naturally be expected. Nor is this all. From time to time a Government Department embarks on a little scientific investigation on its own account. Though started with a purely utilitarian aim, the results cannot but be of some permanent scientific value. The expense attending these investigations must be sought for among the votes taken for the office specially concerned in the inquiry. Such cases will be found under the Public Health Department of the Privy Council, the Chief Secretary for Ireland's Department, the Board of Trade, and the Local Government Board.

For the sake of completeness mention should be made of the sums expended by Royal Commissions and Select Committees, such as the Royal Commission on Scientific Instruction, which was appointed in 1870, that on Technical Instruction in 1881, and the Select Committee to report on the Museums of the Science and Art Department in 1898.

All these have the same characteristic of indefinite variability, and a consideration of their annual fluctuations would lead to no definite result. Without, therefore, ignoring or depreciating the valuable if erratic assistance the State gives from time to time for scientific purposes by providing buildings, appointing commissions, financing expeditions, and carrying out inquiries, it is only by restricting attention to the sums voted year by year in pursuance of a more or less settled scheme that we can truly determine if science instruction is really increasing in volume and effectiveness, and is being made more and more available for all who could derive profit from it. In this connection it may be worth while to recall the words of the Queen's Speech in 1853:—"The advancement of the fine arts and of practical science will be readily recognised as worthy the attention of a great and enlightened Nation, and I have directed that a comprehensive scheme should be laid before you having in view the promotion of these objects towards which I invite your aid and co-operation."

The Rise and Fall of the Science and Art Department.

Before the first International Exhibition of 1851 State aid to education of any type had been practically restricted to an annual grant for elementary schools, which in 1850 had reached the modest sum of 125,000*l.*; to a grant to the University of London of about 4000*l.* spent on examiners, scholarships, exhibitions, and prizes, with practically nothing on salaries; grants for the teaching of drawing in schools of design; and grants to the Royal Dublin Society. The grants for schools of design had crept up year by year from 1300*l.* in 1838 to 14,755*l.* in 1850. The Royal Dublin Society received annually about 6000*l.*, sometimes a little more, sometimes less, and this was supposed to be expended very largely in the promotion of science and art.

In 1853 the new Department of Science and Art was launched, and the Geological Survey, the Geological Museum, and the Museum of Industry, Dublin, put under its charge. The infant South Kensington Museum and the well-established School of Design were also included, and the new organisation began its task of encouraging science instruction. But whatever may have been the views of far-sighted men like Sir Henry Cole, who then, as Mr. Cole, was making history as director, those in actual control were singularly blind to the future. Thus the Board of Trade in a letter to the Treasury in March, 1853, state that "in the proposed Department of Science and Art the motive power will be local and voluntary—the system in the main self-supporting."

In regard to the Geological Survey, it is stated:—"It is important to bear in mind that the expenses incurred on account of the Geological Survey are not permanent in their character, and will ultimately cease

to be a charge upon the public." "Ultimately" is a good word, seeing that the expenses of the survey were in 1852–3 approximately 5500*l.*, while sixty years later, in 1913–14, they were about 17,875*l.*

This short-sightedness was not confined to the Board of Trade, for the Treasury with due solemnity replied that in their opinion "the utility of (science and art) institutions is great in proportion as they are self-supporting."

If this test were applied to our existing science institutions there are few which could claim to be really of great utility.

Of more value was the statement made by the Board of Trade further on in the letter already mentioned that the "assistance received from Parliament will be applied to the general good of all."

With these expressions of policy the Science and Art Department started on its career. The sums annually taken in the Estimate for its manifold activities gradually grew from year to year from 44,476*l.* in 1853–4 to 600,781*l.* in 1898–9. In the following year the amount granted is included in the Estimate for the Board of Education.

For many years the science grants were awarded on the results of examination and attendance. Before a school could claim payment for its work the students had to receive a certain minimum amount of instruction from a recognised teacher, this amount of instruction being spread over a certain number of weeks, so as to enable the instruction to be given systematically, with time for home-work and home-reading. Nothing was paid on account of those students who did not pass the examination at the end of the course, and the amount paid depended upon the grade of success, varying from a minimum of 1*l.* to a maximum of 5*l.* On the results of these examinations the National Scholarships, Royal Exhibitions, Whitworth Scholarships and Exhibitions, were also awarded and the examinations are still temporarily retained for this purpose.

It is of course easy to criticise this system but at the time it was instituted, examination was much more popular as a universal test of attainment than it is at present. At a time when children of tender years were being coached to pass an individual examination in reading, writing, and arithmetic not to mention a number of additional subjects, it was only natural that the same tests should be applied to the older students found in evening classes.

A centralised examination meant also the publication of official syllabuses for each of the branches of science in which examinations were held. These no doubt in time tended to cramp and stereotype the teaching but this ill effect was minimised by the fact that the examination papers always contained more questions than the candidate was permitted to answer and he was thereby enabled to select those parts of the subject which had formed the principal portion of his instruction or in which he was specially interested. It should also not be forgotten that in the case of the great majority of the candidates, certainly in the case of those above 16 years of age, the examination was looked forward to as a necessary crown to the session's work. With much that was feeble and almost worthless, and in spite of cramming and learning by rote, there was a substantial amount of good grain winnowed from the chaff and many a man can trace back his love of science or his success in life to what he learnt in science classes and to the rewards he gained through this much maligned examination system.

It must also be remembered that with few exceptions the examinations were in pure and not applied science, the underlying idea being to foster the study of the scientific principles on which our productive industries depend and to leave the practical working out of these principles to an enlightened self-interest. Nowadays applied science seems to have swept all before it and in the desire for quick results the need of a firm foundation of scientific principles is apt to be ignored.

The Science and Art Department stuck steadily for many years—perhaps too tenaciously—to the pure sciences and only extended its assistance generally to applied science when the system of payment on attendance and results gave way to the system of payment on attendance alone.

One of the early results of the change was distinctly beneficial. Under the examination system the only practical work in science for which grants were obtainable was in chemistry and metallurgy. When payment on attendance alone was established grants for practical work in physics were obtainable and physical laboratories began to be built and equipped. Especially was this the case in the day schools which had grown out of the science classes established in the elementary schools. In these schools—the organised science schools or schools of science as they were called—13 hours each week had to be devoted to mathematics, science, drawing, and manual instruction and the science had to include a definite proportion of laboratory work. The success of these schools so far as their rapid increase in number and in attendance was concerned was undoubted. Not only did the so-called higher grade elementary schools adopt the system but numbers of endowed secondary schools followed suit. For these latter the requirement of a definite amount of time per week for science and art work was often irksome and the close similarity of the curriculum in the higher grade and in the secondary school led to fears of competition and overlapping.

Inquiry showed that these fears were largely imaginary, but as at the time the State was developing its scheme of assistance to secondary education, the organised science school became officially unpopular and the discovery that school boards could not legally carry on such schools was the deathblow to systematised science teaching in connection with elementary day schools. The attempts to soften the blow by the establishment of higher elementary schools was unsuccessful in spite of much official pressure. The original minute under which these schools were to work was a marvel of restrictive officialism and though the stringency of the original regulations was subsequently relaxed the higher elementary school never prospered and nothing has yet effectively taken the place of the defunct organised science school. It remains to be seen whether the new junior technical schools, which after years of repression have forced their way into official recognition and favour, will fill the gap in the education of the elementary school boy or girl who, having gone through the ordinary elementary school course, has had neither the desire nor the opportunity to carry his training further in a secondary school.

Building Grants for Local Science Schools.

Aid was first granted towards the building of science schools in 1868, grants in favour of schools of art having been in existence since 1856. The rate of grant was half-a-crown per sq. ft. of floor space up to a maximum of 500*l.* The grant was withdrawn in 1897, but applications for aid received before that decision was published were accepted, and the claims so acknowledged were not finally liquidated until 1902. Thus, for a period of thirty-four years State aid was given towards the provision of suitable buildings for science instruction. It is of interest to

see how this aid was appreciated. During the first half of the time 1868–1884 the grants paid amounted to 4,862*l.* 15*s.*, representing about 39,000 sq. ft. of floor space; during the second half of the term 1885–1902 the grants paid amounted to 43,183*l.* 15*s.*, representing 345,470 sq. ft. of floor space, or more than eight times as much as in the earlier period. In fact, before the edict went forth withdrawing this help the annual expenditure had crept up to nearly 4000*l.* a year, representing at least eight additional technical schools per annum. The remarkable increase during the latter half is due partly to the stimulus afforded to local authorities by the various Technical Instruction Acts, but public subscription provided no inconsiderable portion of the total, and it must be remembered that the State aid was only a small fraction of the total cost. It would be no exaggeration to say that this expenditure of public money of 48,000*l.* represented half a million of local funds devoted to building and equipping science and technical schools and institutes.

In addition to the aid given to science teaching by the payment made to teachers or to local committees on examination results, the science and art department promoted science instruction in a number of ways, which, without much expenditure of State funds, stimulated local interest and encouraged local expenditure for science purposes.

Among these minor influences the chief place must be given to the Royal Exhibitions and National and Local Scholarships, and with these should be coupled the Whitworth Scholarship and Exhibitions founded in 1867, which the department administered under Sir Joseph Whitworth's trust. These, fortunately—with the exception of the Local Scholarships—still continue, but it is doubtful if under present regulations they give the same opportunity to the working artisan as in the early days of their first establishment.

Grants towards the provision of laboratory fittings and toward the purchase of apparatus also served to encourage proper provision for experimental teaching at better total cost to the State. These also have disappeared, although it is still possible in certain circumstances to get aid toward the purchase of museum objects.

Prizes and medals were also in the early days found useful in encouraging students and incidentally in distributing among the successful competitors books which were of use in further prosecution of their science work.

These rewards, like the fittings, the apparatus, and the building grants, have now disappeared, and the amounts spent on them no longer appear separately in the estimates. It is doubtful, however, if the country has been saved the expenditure; like the recent savings resulting from the partial abolition of the May examinations, it may possibly reappear in the guise of an increase in the number of officials.

Science in Elementary Schools.

In the early years of State aid to elementary education no attention was paid to the claims of science beyond a pathetic desire that budding teachers should be encouraged to come forward for examination in land-surveying.

But with the rise of class subjects and the addition of "specific subjects" to the code in 1867, science teaching in elementary schools awoke. Special grants were made both for "class subjects" and for "specific subjects" on each child who passed the examination in the subject held annually by H.M. inspector. But very few inspectors either had much knowledge of or much love for science. Nearly all had been appointed for their literary or mathematical attainments, and it is not, therefore, surprising that the majority of the inspectors discouraged schools and teachers from taking science among the specific subjects. This was so generally evident that the British Association appointed a committee in 1879 specially to inquire into the matter. This committee was re-appointed with slightly varying functions from year to year until 1904, when it was reconstructed and the scope of its operations modified. Its annual reports contain statistics as to the various branches of science taken as specific subjects and as to the number of children taught, and it added from time to time some well-deserved criticisms on the general system.

In spite of general official discouragement, much admirable work was done, Liverpool and Birmingham being especially active in this respect. Those who had the opportunity of seeing some of the science teaching at these places can testify to the soundness with which it was given and to the genuine interest taken in it by the children.

By the year 1878–9 there were 29,459 children examined in physical geography, 20,506 in animal physiology, 1621 in mechanics, and 1332 in botany. Ten years later physical geography had disappeared, apparently having ceased to be a "specific subject" and become a "class subject" under the guise of elementary science. Animal physiology shows a falling off to 15,893 children examined, mechanics a big rise to 9651, botany a slight increase to 1944, while chemistry was taken by 1531 pupils, sound, light, and heat by 1076, magnetism and electricity by 1669, and principles of agriculture by 1199. We again pass on ten years, and find that in 1898–9 the numbers in animal physiology had grown to 41,244, in mechanics to 50,324, and in botany to 8833. Chemistry shows almost a tenfold increase to 14,737, magnetism and electricity had grown to 7697, sound, light, and heat to 1943, while principles of agriculture remains inactive at 1163. Various other branches of science also appear, with among them nearly 10,000 more. Science teaching in the elementary school seems to be flourishing, but a few years later the system of payment is altered; "specific subjects" disappear, and the teaching of science rapidly changes and then dies down.

The breaking down of the system by which the grants were made to depend upon class subjects and specific subjects, and the merging of these in the general course of the elementary-school curriculum, was no doubt educationally sound, but it certainly has had one effect: the reduction in the amount and the standard of science instruction; while the policy itself has not yet been effectually completed, since separate grants are still obtainable for "special subjects" such as handicraft, cookery, laundry-work, gardening, and dairywork.

There can be no doubt that there is less real systematic science teaching in our elementary schools than was the case twenty years ago, and that the proportion of the total expenditure on elementary education which can be looked upon as spent in promoting science instruction is decidedly less not only in proportion but in amount.

State Aid for Science in the Secondary Schools and the Universities.

State aid to secondary education grew out of the grants made to science classes. These classes were held at first only in the evening, but after a little some began to meet in the daytime. Some of the

private schools and less well endowed grammar schools, attended partly by children of parents who might be described without much inaccuracy as belonging to the "industrial classes," began to realise that they might get help from the Science and Art Department. On its side the department promised an additional grant, first of 10*s.* and then of 1*l.* per head for pupils taking a definite course of science work, and passing successfully in at least one of the subjects of the course. Thus arose the organised science school. As has already been stated, most of the grammar schools found that the requirements of the department for an organised science school were too severe, and continued to get aid for separate science classes, and the organised science school scheme was for a time mainly worked either by schools of a more or less private character, by schools held in mechanics' institutes as at Leeds and Keighley, or by school boards. In fact, the organised science schools promoted and carried on by the bigger boards, as at Manchester, Salford, Bolton, Sheffield, and many other places, were so successful as to cause alarm to the grammar and endowed schools. A lively controversy arose in which the catchwords of overlapping and co-ordination made a frequent appearance.

By various modifications in the regulations, the purview of the Science and Art Department in the organised science schools was extended, first to requiring a certain amount of non-science work, secondly insisting on the teaching of at least one language other than English, and finally by requiring the whole of the secular portion of the curriculum to be submitted to inspection. This, with the alteration of the grant from one depending on results and attendance to one on attendance alone completed the process by which a large number of secondary schools found themselves in receipt of State aid and open to State inspection.

But this change was no sooner complete than the insistence on science instruction, which was the basis of the early system, was relaxed, till in the present day, when a grant of 774,000*l.* is taken for aid to secondary schools, none of it can be said to be specifically devoted to science instruction, although science must, as a general rule, form part of the school course. It is not too much to say that the weight of official recognition has passed from the scientific to the literary side of the secondary school, and that the time and energy devoted to instruction and practical work in science have shown a remarkable decrease. So much for the secondary school. We now come to the universities and the university colleges. Here the State aid has taken a variety of forms. The grant to London University began in 1839 with a modest 5,050*l.* for the expenses of examiners in various branches of knowledge, among which science held a worthy place. Expenses of administration were from time to time brought within the scope of the vote.

After the year 1891–2 the special vote for the London University practically disappears from the estimates. There had always been considerable receipts paid into the Exchequer, so that the sums actually voted had long ceased to represent a clear grant from the State, and in the succeeding ten years only modest sums from 100*l.* downwards are entered under this vote. At the same time, gradually increasing sums were voted for distribution among the universities and university colleges and the constituent colleges of the London University received, and still receive, substantial sums in this way.

The universities and the university colleges have enjoyed State assistance in a number of ways. First and for long the most important of these aids was the annual grant administered by the Treasury, and applied to what was considered by the Treasury advisers the proper work of universities—literature, mathematics, and pure science, excluding rigidly any applied science or technology, if such there chanced to be within the sacred precincts. This aid began in 1883–4 with a modest grant of 4000*l.* for the University College of Wales. It was increased to 8000*l.* in 1884–5, to 11,500*l.* in 1885–6, to 12,000*l.* in 1886–7, and to 14,000*l.* in 1887–8 and 1888–9. In the following year England begins to participate in the grant under this vote, and its subsequent fortunes are as follows:—

	£		£		£
1889–90	44,785	1898–99	104,507	1907–8	201,400
1890–91	71,000	1899–1900	105,700	1908–9	221,800
1891–92	71,000	1900–1	105,500	1909–10	217,400
1892–93	71,000	1901–2	116,700	1910–11	218,100
1893–94	83,000	1902–3	121,706	1911–12	303,800
1894–95	86,098	1903–4	119,100	1912–13	314,200
1895–96	98,339	1904–5	151,200	1913–14	314,300
1896–97	102,179	1905–6	197,300		
1897–98	104,059	1906–7	200,400		

A portion of this vote, about 28,000*l.*, is, however, specifically voted for the purpose of Welsh intermediate education, and should, in fact, not appear here but in the vote for secondary education.

In addition, the universities and university colleges have received considerable benefit from the grants paid for the training of elementary-school teachers in the day training colleges.

Some instruction in science has always been a necessary portion of the training course, though it it must be admitted that the emphasis laid upon it in the day training colleges was always less than in the better residential colleges, and has in recent years evolved or degenerated (according to the views taken of its importance as a branch of training) into nature study or general experimental science. The principal value of this variety of State aid has been, not in any stimulus given to science instruction, but in the support it afforded in the early years of these colleges and universities to their arts side, a side which, without these day training students, would often have been non-existent.

The earliest mention of the State solicitude for the training in science of the future teachers in State-aided schools appears, as already stated, in the directions to inspectors in 1845 that inquiries should be made as to the attainments of the teacher in land surveying—an attempt presumably to give a rural bias to elementary education—the rural bias which, after seventy years, we are still seeking to impart. A more serious attempt was made in the newly-founded training colleges of St. Mark's, Chelsea, St. John's, Battersea, and Chester, where from the first some one or more subject of science—and we may also add—of handicraft, were included in the training course, and we may be certain that the inspector who reported on these colleges—Canon Moseley—was not unsympathetic to this infant attempt at a real general education.

Science teaching continued to flourish at the training colleges for many years. Laboratories were gradually built and fitted up, systematic practical work undertaken, and in the more powerful and well-equipped colleges an increasing proportion of their students were enabled to obtain the B.Sc. degree or the Inter B.Sc. of the University of London. Then came a period of official repression, when rightly or wrongly the attempt was made to devote the training college time more exclusively to the professional side

of the schoolmaster's calling, and to discourage the working for degrees.

The growth of the day training colleges and their intimate connection with the universities has, however, rendered of slight effect the attempt to divert students from the degree studies, and the present tendency seems to be rather to encourage this university training by the grant of facilities for lengthening the training college course beyond its normal two years' duration.

The universities and university colleges had a third source of income from the State, although a very small and variable one, in the fees paid by the Science and Art Department for the attendance of teachers at science courses, and in the aid given toward the establishment of local exhibitions tenable at the colleges. Though the amount of the aid has been trifling so far as the actual sums are concerned, the effects have been remarkably good. Many a man now holding a good position in the scientific or industrial world can trace his success to the opportunities given him by these local exhibitions to pursue a course of systematic study in a fairly well-equipped institution of university rank. This is still more true of the Whitworth scholarships and exhibitions which were at one time generally held at an institution of this type.

But the most elastic source of Government aid to science work in the university was tapped for the first time when it was made clear to the university authorities that the Regulations of the Technical Branch of the Board of Education definitely offered assistance to "any institution in which systematic instruction in science or science and art was given." It only remained for the university to place, under the supervision of the Board of Education, the work in the applied sciences which the Treasury officers declined to recognise. After the first plunge was made one after another succumbed to the fascinating bait, and now all the universities in the country receive aid from the Board of Education for at least some portion of their work. The fears at first naturally felt that the acceptance of the Board's aid would result in fettering the teaching or the administration have so far proved in practice to be unfounded.

Following the example of the universities came the medical schools attached to the London hospitals, and the same elastic regulations enabled them, too, to be admitted to their share in the sums available for technical instruction. The first grant under this head was one of 1,000*l.* to St. Mary's Hospital Medical School in the year 1908–9. For the last financial year for which figures are available, a sum of 15,600*l.* was distributed among eleven medical schools—a very substantial and acceptable increase—while the total grant, including the universities and the university colleges, was 44,600*l.*—a sum, be it remembered, in addition to the Treasury grant.

It will therefore be seen that State aid towards science teaching of university standard has shown a distinct upward tendency, but a tendency more marked in regard to applied science, less obvious in regard to pure science.

State Aid for Agricultural Education.

State aid towards agricultural education began in 1888–9 with a grant of 5,000*l.* to the Agricultural Department of the Privy Council, and in 1890–1 the Board of Agriculture came into being. In the year following the creation of the new Department the amount voted had grown to 8,000*l.* It remained at this figure till 1895–6 when 1700*l.* was transferred to the Scottish Education Department.

By 1897–8 the expenditure had risen again to 7200*l.* In 1901–2 it was 8900*l.*, and ten years later had grown still further to 19,500*l.* In this year the Board of Agriculture captured the president of the Board of Education, and shortly after completed its triumph by annexing almost all the agricultural instruction formerly aided by the Board of Education and 6000*l.* of its grant. The Board of Education still controls and aids the pleasing and harmless fad of school gardens in connection with elementary schools and with evening schools for youths not over sixteen years of age. Thus, one whole branch and that not the least in importance has been definitely removed from the control of the State Department specially created to deal with education and put under another responsible for swine fever and cattle disease, ordnance survey, and the regulation of commons.

The change appears to have commended itself to the country and to the farming interest, for the grants for the present year are on a scale far in advance of anything before. The vote for agricultural education is 98,250*l.*, for forestry education 1000*l.*, for general agricultural research 43,815*l.*, for forestry research 1200*l.*, and for animal and plant pathology 18,650*l.*, making a total grant of 163,000*l.*, as against one of 78,000*l.* for the preceding year. But this is not all the State aid to agriculture. Scotland gets 51,184*l.* and Ireland 49,750*l.* In addition, there is a grant of just over 7000*l.* for fishery investigations. The obvious moral of these figures seems to be that technical instruction and research develop rapidly when confided to the care of an authority specially entrusted with this duty, instead of to one immersed in other and more immediately popular types of education.

State Aid for Scientific Research and to Learned Societies.

Finally we come to the aid given by the State towards scientific research. The total amount of the aid is, however, uncertain, and it is easy to omit items in various votes which might conceivably be properly classified under this heading. For our purpose the most important portions of this aid are (1) the research grant administered by the Royal Society. This began in 1850 with a sum of 1000*l.* and continued, in spite of some alarms of a possible withdrawal, till 1876, when an additional grant of 4000*l.* for five years was made. In 1882 the original grant of 1000*l.* and the additional grant of 4000*l.* were replaced by a single sum of 4000*l.*, and it has remained at that sum to the present time. An application for an increase was made in 1894, but not granted, but, possibly as a compromise, a grant of 1000*l.* was made towards the expense of the publication of scientific researches, and this grant still continues to appear annually in the estimates.

State aid to the various scientific societies of the country may be best dated from the year 1854–5, when a grant of 500*l.* was made to the Royal Geographical Society, and the grant has continued at the same amount. As already stated, the Royal Society grant of 1000*l.* was in 1856–7 definitely inserted in the Annual Estimates, but similar amounts had in fact been granted since 1851, the amounts for the succeeding years to 1855 being looked upon as special and not necessarily annual. In 1866–7 the Royal Society of Edinburgh secured 300*l.*, and in 1869–70 these three votes, with the grants for scientific investigations, were classified together as Votes for Learned Societies with a total of 12,300*l.* The subsequent history of this Vote is shown in the following table:—

	£			£			£
1870–71	12,370	...	1885–86	21,400	...	1900–01	50,724
1871–72	12,450	...	1886–87	24,400	...	1901–02	53,154
1872–73	12,450	...	1887–88	23,500	...	1902–03	68,396
1873–74	12,450	...	1888–89	21,900	...	1903–04	90,780
1874–75	13,300	...	1889–90	27,603	...	1904–05	46,407
1875–76	12,550	...	1890–91	25,253	...	1905–06	53,900
1876–77	12,550	...	1891–92	25,790	...	1906–07	57,650
1877–78	15,550	...	1892–93	25,896	...	1907–08	54,479
1878–79	17,050	...	1893–94	26,163	...	1908–09	56,295
1879–80	17,050	...	1894–95	26,247	...	1909–10	57,964
1880–81	17,050	...	1895–96	26,827	...	1910–11	74,228
1881–82	21,600	...	1896–97	28,154	...	1911–12	61,603
1882–83	20,900	...	1897–98	27,984	...	1912–13	125,523
1883–84	23,650	...	1898–99	28,452	...	1913–14	99,708
1884–85	23,400	...	1899–00	36,724			

On the whole, this may be looked upon as evidence that there is a recognised body of feeling in favour of annual subsidies of this character. The large fluctuations in the amounts are due to the initiation or the completion of the principal expenditure on various new branches of work, *e.g.* the National Library of Wales, the Antarctic Expedition, the Sub-Wealden Exploration, the North Wales University College, and so on. The vote is in fact the collection of miscellaneous items of expenditure, all of which may be said to be in some degree scientific in character, and which are, therefore, appropriately grouped under Class IV., Education, Science, and Art.

It has not been found possible to trace the grants specially allotted to Scotland and Ireland with any approach to accuracy. In the earlier years they were included in those for England and Wales. First one and then another item was removed and committed to the control of a department of the nation concerned. In this way the vote for Scottish Education appeared separately for the first time in 1875–6, and that for the Irish Department of Agriculture and Technical Instruction in 1899.

For the current financial year 1914–15, the votes for Scientific Investigation, etc.—the Societies being presumably the etc.—is apportioned as follows:—

	£
1. Royal Society Scientific Investigations...	4,000
Royal Society Scientific Publication ...	1,000
Royal Society Magnetic Observatory, Eskdalemuir	1,000
Royal Society National Physical Laboratory	7,000
Royal Society National Physical Laboratory, Aeronautical Section ...	12,550
2. Royal Society, Edinburgh	600
3. Meteorological Office	20,000
4. Scottish Meteorological Society	100
5. Royal Geographical Society	1,250
6. Royal Geographical Society of Scotland	200
7. Marine Biological Association	1,000
8. Royal Zoological Society, Ireland ...	500
9. International Geodetic Association ...	300
10. Solar Physics Observatory	3,000
11. North Sea Fisheries Investigation ...	1,250
12. British Antarctic Expedition	5,000
13. Edinburgh Observatory	1,637
14. International Seismic Association ...	210

Either the Scientific Investigation or the etc. also covers grants to the Royal Academy of Music, the Royal College of Music, Royal Irish Academy of Music, the Royal Irish Academy, the Royal Hibernian Academy, the British School at Athens and at Rome, the British Academy, and the National Library and National Museum of Wales. Among them they take 40,100*l.* of the total.

The conclusions to be drawn from these facts are simple and evident. The aid given by the State towards the advancement of science has increased in amount and variety so far as applied science is concerned. Questions dealing with matters of immediate utility connected with physics, biology, pathology, or agricultural practice have secured the attention of the State with a fair measure of success. But the support and encouragement formerly given to pure science have dwindled down till they are now almost lost among the grants given for the study of Shakespeare and tailors' cutting, the practice of cooking and Morris dancing, or the cultivation of languages from ancient Greek to modern Esperanto. All excellent objects, and all deserving of the nation's support, but in their rapid growth they bid fair to choke the tender plant of pure science, to the prior existence of which they owe their own flourishing condition, and the early struggles of which ensured their own success.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

LONDON.—A course of six lectures on the international crisis in its ethical and psychological aspects will be given at Bedford College, Regent's Park, on Fridays, at 5.15, beginning on February 5. The lectures have been arranged by the council of Bedford College in co-operation with the Committee of Imperial Studies of the University of London, and are open to the public without charge. Viscount Haldane, visitor of the college, will be in the chair at the first lecture, when Mrs. Henry Sidgwick will speak on the morality of strife in its relation to the war. The other lecturers will be Prof. Gilbert Murray, Dr. A. C. Bradley, Dr. L. P. Jacks, Prof. Stout, and Dr. Bernard Bosanquet.

SEVERAL bequests for higher education are chronicled in the issue of *Science* for December 25 last. Mr. J. Arthur Beebe has bequeathed 30,000*l.* to the building club of the Harvard Club of Boston; 2000*l.* to the fund of the Harvard class of 1869, of which class he was a member, and 1000*l.* to Dr. F. C. Shattuck for investigations of tropical diseases. The residue of the estate, after some personal bequests have been paid, is bequeathed to Harvard University, the income to be used for the general purposes of the University. The University of Pennsylvania will be the ultimate beneficiary of the 40,000*l.* estate of the late Mr. William B. Irvine, ex-city treasurer, who died December 6. The money will provide either a building for a school of mining engineering or an auditorium.

DURING the second week of the year no fewer than twenty educational associations held meetings in London. The quality of the papers read was in many cases very high, and the attendances were such as fully to justify the organisers in their refusal to listen to those who suggested postponement on account of the war. The sense of national crisis deepened and strengthened the tone of the addresses whenever the subject under discussion was felt to concern national progress. It was the rule that the debates dealt with wide issues, and the fact that a drop in quality and interest affected the exceptional instances when minutiæ of the class-room or examination-hall fell to be discussed is perhaps scarcely a matter for regret. The problems of suitable science work to be undertaken in schools, including the aim of such work and its national influence, obviously rank among the matters which need statesmanlike handling in the near future. In her address to the Science Teachers' Association, Mrs. Bidder discussed the scientific training most suitable for girls, and urged that the work should be manual and scientific, so that girls could handle things and obtain a scientific attitude of mind. Elementary physical and chemical work should lead

to appreciation of scientific method and scientific accuracy. Domestic work might be taught as an art or craft, and more things might be taught in the home—by which was not meant an increase in "home lessons." Girls could be taught to express themselves clearly through science lessons. The address was practical, and will no doubt be helpful to the science mistresses who heard it. It is a matter for great regret that no other paper on science teaching in schools (above the stage of nature-study) appeared at the conferences during Education Week, 1915. The presidential address delivered by Sir George Greenhill before the Mathematical Association upon the subject of mathematics in artillery science, did, however, deal largely with the unsatisfactory position which science occupies in the training of artillery officers.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, December 18, 1914.—Dr. A. Russell, vice-president, in the chair.—H. R. **Nettleton**: A vacuum guard-ring and its application to the determination of the thermal conductivity of mercury. A specially constructed vacuum vessel heated at the top by steam and cooled at the bottom by flowing water, is used to find the thermal conductivity of mercury. The vacuum acts as a guard-ring, which is at the same time not open to the well-known objection of communicating to the calorimeter a quantity of heat difficult to estimate. So efficient is the vacuum that the temperature gradient, as measured by a single thermo-junction carried by a cathetometer, is probably not in error to the extent of 1 part in 500. The mean value obtained for the thermal conductivity of mercury in a set of twenty-four experiments is 0·01960 c.g.s. units over the range 35° C. to 45° C. The remarkable linear nature of the temperature gradient obtained within the vessel, the cross-section of which was very uniform over the larger range of temperature, 35° C. to 65° C., would indicate at least that there is no diminution of thermal conductivity with rise of temperature.

BOOKS RECEIVED.

A Text-Book of Practical Assaying. By Prof. J. Park. Revised and enlarged edition. Pp. xii+342. (London: C. Griffin and Co., Ltd.) 7*s*. 6*d*. net.

Practical Field Botany. By A. R. Horwood. Pp. xv+193. (London: C. Griffin and Co., Ltd.) 5*s*. net.

A First Book of Commercial Geography. By T. Alford Smith. Pp. viii+151. (London: Macmillan and Co., Ltd.) 1*s*. 6*d*.

Calculus Made Easy. By F. R. S. Second edition. Pp. xi+265. (London: Macmillan and Co., Ltd.) 2*s*. net.

What Do We Mean by Education? By Prof. J. Welton. Pp. xii+257. (London: Macmillan and Co., Ltd.) 5*s*. net.

Fundamental Sources of Efficiency. By Dr. F. Durell. Pp. 308. (Philadelphia and London: J. B. Lippincott Co.) 10*s*. 6*d*. net.

Logic: Deductive and Inductive. By C. Read. Fourth edition. Pp. xvi+417. (London: A. Moring, Ltd.) 6*s*.

Directions for a Practical Course in Chemical Physiology. By Dr. W. Cramer. Second edition. Pp. viii+102. (London: Longmans and Co.) 3*s*. net.

DIARY OF SOCIETIES.

THURSDAY, JANUARY 14.

INSTITUTION OF ELECTRICAL ENGINEERS at 8.—The Shape of the Pressure Wave in Electrical Machinery: Dr. S. P. Smith and R. S. H. Boulding.

MATHEMATICAL SOCIETY, at 5.30.

MONDAY, JANUARY 18.

ROYAL SOCIETY OF ARTS, at 8.—Oils, their Production and Manufacture: Dr. F. Mollwo Perkin.

VICTORIA INSTITUTE, at 4.30.—Modernism and Traditional Christianity: Rev. Canon E. M'Clure.

TUESDAY, JANUARY 19.

ROYAL INSTITUTION, at 3.—Muscle in the Service of Nerve: Prof. C. S. Sherrington.

ROYAL STATISTICAL SOCIETY, at 5.

ILLUMINATING ENGINEERING SOCIETY, at 8.—*Discussion*: Some Points in Connection with the Scientific Development and Practical Applications of Searchlights.

WEDNESDAY, JANUARY 20.

ROYAL SOCIETY OF ARTS, at 8.—The Textile Industries of Great Britain and Germany: J. A. Hunter.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Annual General Meeting. Followed by an Account of the Proposed Climatological Atlas of the British Isles.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Notes on the History of the Microscope: Dr. C. Ginger.

ENTOMOLOGICAL SOCIETY, at 8.—Annual Meeting.

GEOLOGICAL SOCIETY, at 8.—The Geology of the District around Machynlleth and the Llyfnant Valley: O. T. Jones and W. J. Pugh.—The Geology of the District between Abereiddy and Abercastle (Pembrokeshire): A. H. Cox.

THURSDAY, JANUARY 21.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: Atmospheric Electricity Potential Gradient at Kew Observatory, 1898–1912: Dr. C. Chree.—Electromagnetic Waves in a Perfectly Conducting Tube: L. Silberstein.—An Electrically-heated Full Radiator: H. B. Keene.—The Transmission of Electric Waves over the Surfaces of the Earth: Prof. A. E. H. Love.

ROYAL INSTITUTION, at 3.—Modern Theories and Methods in Medicine: H. G. Plimmer.

ROYAL SOCIETY OF ARTS, at 4.30.—Nepal: H. J. Elwes.

LINNEAN SOCIETY, at 5.—Report on the Fishes Collected by Mr. Cyril Crossland in the Sudan: Miss Ruth C. Bamber.—Narrative of his Recent Visit to the Houtman Abrolhos Archipelago, West Australia: Prof. W. J. Dakin.

INSTITUTION OF MINING AND METALLURGY, at 8.

FRIDAY, JANUARY 22.

ROYAL INSTITUTION, at 9.—Problems of Hydrogen and the Rare Gases: Sir J. Dewar.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.

PHYSICAL SOCIETY, at 5.—Practical Harmonic Analysis: Dr. A. Russell.—Measuring the Focal Length of a Photographic Lens: T. Smith.

SATURDAY, JANUARY 23.

ROYAL INSTITUTION, at 3.—Aerial Navigation—Scientific Principles: Dr. R. T. Glazebrook.

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